B.Tech

CURRICULUM and SYLLABUS

Regulation 2018

(For the Students Admitted from the Academic Year 2018-19 Onwards)

DEPARTMENT OF AERONAUTICAL ENGINEERING

Kalasalingam Academy of Research and Education

(Deemed to be University)
Under sec.3 of UGC Ac,1956. Accredited by NAAC with 'A' Grade
Anand Nagar, Krishnankoil-626126,
Srivilliputtur (via), Virudhunagar (Dt), Tamilnadu, India.
www.kalasalingam.ac.in

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION

To be a Centre of Excellence of International Repute in Education and Research.

To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research.

DEPARTMENT OF AERONAUTICAL ENGINEERING

To be a Centre of Excellence in Education and Research in the field of Aeronautical Engineering to meet global requirements of Industry and Society.

- To impart quality education and research in Aeronautical Engineering through excellence in teaching - learning process and state of art facilities to the students.
- To inculcate students with ethical values and innovative ideas for future leadership in industry and to face societal challenges.

Program Educational Objectives

PEO-1- DIVERSIFIED KNOWLEDGE
Graduates will apply fundamental technical knowledge and skills to find workable solutions to technological challenges and problems in diversified areas such as Aerodynamics, Propulsion, Structures, control systems, Design, and allied fields of Aeronautical Engineering.

PEO-2: CONTEMPORARY ISSUES & SKILLS
Graduates will have an effective communication skills and will recognize the social impacts of problem solving, decision making and creative skills by understanding contemporary issues.

PEO-3: PROFESSIONAL ATTITUDE
Graduates will gain professional and ethical attitude towards their peers, employers, society and prove as a responsible leader in the establishments in government and private sectors.

PEO-4: PROFESSIONAL DEVELOPEMENT
Graduates will become entrepreneurs to confront business challenges or will continue their professional advancement through their knowledge horizon and inculcate lifelong learning.

Program Outcomes (POs)

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 - The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 - Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO1 - An ability to utilize the gained knowledge of Aeronautical engineering in design and development of new products for challenging environment.

PSO2 - An ability to design, analysis and solve the problems of components in flight vehicles imparted by simulation skills.

PSO3 - An ability to fabricate, test and develop the products through in-house and industry practices.

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DEPARTMENT OF AERONAUTICAL ENGINEERING (R-2018)

S. No.	Category	Credits
I	Basic Sciences and Mathematics	25
II	Humanities and Social Science	03
III	Soft Skills	03
IV	Basic Engineering	24
V	Program Core	
	a) Core Courses	48
	b) Community Service Project	03
	c) Project work	10
VI	Elective Courses	
	a) Major Elective	18
	b) Open Elective (Engineering stream)	12
	c) Open Elective (Basic Sciences and Mathematics)	06
	d) Humanities Elective	06
VII	Internship/Industry Training	02
VIII	Mandatory courses	--
	Total Credits	**160**

I. Basic Sciences and Mathematics

S. No	Course Code	Course Name	Course Type	L	T	P	C
1.	PHY 18R183	Oscillations, Waves and Optics	IC	3	0	2	5
2	CHY18R181	Chemistry	IC	3	0	2	5
3	MAT18R101	Calculus & Linear Algebra	T	4	0	0	4
4	MAT18R102	Multiple Integration, Ordinary Differential Equations and Complex Variable	T	4	0	0	4
5	MAT18R203	Partial differential Equations, Probability and Statistics	T	4	0	0	4
6	BIT18R101	Biology	T	3	0	0	3
Total Credits				**25**			

II. Humanities and Social Science

S.No.	Course Code	Course Name	Course Type	L	T	P	C
1.	HSS18R151	English for technical communication	TP	3	0	1	3
2.	HSS18R201	Soft skills-I	T	3	0	0	1
3	HSS18R202	Soft skills-II	T	3	0	0	1
4	HSS18R301	Soft skills-III	T	3	0	0	1
Total Credits				**06**			

III. Basic Engineering

S. No.	**Course Code**	**Course Name**	**Course Type**	**L**	**T**	**P**	**C**
1.	EEE18R172	Basic Electrical Engineering	IC	3	1	2	5
2.	MEC18R101	Engineering Graphics & Design	T	1	0	3	3
3.	MEC18R211	Engineering Mechanics	T	3	1	0	4
4.	CSE18R181	Programming for problem solving	IC	3	1	2	5
5.	MEC18R181	Engineering Practice Laboratory	L	1	0	3	3
6.	ECE18R101	Basic Electronics Engineering	T	3	1	0	4
Total Credits				**24**			

IV. Program Core

Core Courses:

S.No.	Course Code	Course Title	Course Nature	Pre-requisite	L	T	P	C
1	AER18R271	Strength of Materials	IC	-	3	0	2	4
2	AER18R272	Fluid Mechanics	IC	–	3	0	2	4
3	AER18R201	Principles of Flight	T	-	3	0	0	3
4	AER18R202	Aero Thermodynamics	T	-	3	0	0	3
5	AER18R203	Kinematics and Dynamics of Machines	T	-	3	0	0	3
6	AER18R273	Aerodynamics –I	IC	AER18R272	3	0	2	4
7	AER18R274	Aircraft Structures - I	IC	AER18R271	3	0	2	4
8	AER18R275	Propulsion - I	IC	-	3	0	2	4
9	AER18R371	Aerodynamics - II	IC	AER18R273	3	0	2	4
10	AER18R372	Aircraft Structures-II	IC	AER18R274	3	0	2	4
11	AER18R373	Propulsion - II	IC	AER18R275	3	0	2	4
12	AER18R281	Aircraft Component Drawing Laboratory	L	MEC18R101	0	0	3	2
13	AER18R301	Flight Dynamics	T	AER18R371	3	0	0	3
14	AER18R481	Aero-Design Project	L	AER18R301	0	0	3	2
Total Credits					**48**			

Community Service Project:

S. No.	Course Code	Course Name	L	T	P	C
1.	AER18R399	Community Service Project	0	0	3	3

Project work:

S. No.	Course Code	Course Name	L	T	P	C
1.	AER18R499	Project Work	0	0	26	10

V. Elective Courses

Major Electives:

S. No.	Course Code	Course Name	Course Nature	Pre-requisite	L	T	P	C
1.	AER18R302	Aircraft Systems and Instruments	T	-	3	0	0	3
2.	AER18R303	Aerospace Materials	T	-	3	0	0	3
3.	AER18R304	Aircraft Design	T	-	3	0	0	3
4.	AER18R305	Aircraft Engine Repairs and Maintenance	T	-	3	0	0	3
5.	AER18R306	Aircraft Rules and Regulations CAR I & II	T	-	3	0	0	3
6.	AER18R307	Approximate Methods in Structural Mechanics	T	-	3	0	0	3
7.	AER18R308	Finite Element Methods	T	-	3	0	0	3

8.	AER18R309	Boundary Layer Theory	T	-	3	0	0	3
9.	AER18R310	Fatigue and Fracture Mechanics	T	-	3	0	0	3
10.	AER18R311	Fundamentals of Control Engineering	T	-	3	0	0	3
11.	AER18R312	Missile Aerodynamics	T	-	3	0	0	3
12.	AER18R313	Structural Dynamics	T	-	3	0	0	3
13.	AER18R314	Theory of Plates and Shells	T	-	3	0	0	3
14.	AER18R315	Wind Engineering	T	-	3	0	0	3
15.	AER18R316	Acoustics and Noise Control	T	-	3	0	0	3
16.	AER18R401	Aero Elasticity	T	-	3	0	0	3
17.	AER18R402	UAV System Design	T	-	3	0	0	3
18.	AER18R403	Heat Transfer	T	-	3	0	0	3
19.	AER18R404	Launch Vehicles and Missiles	T	-	3	0	0	3
20.	AER18R405	Airframe Repair and Maintenance	T	-	3	0	0	3
21.	AER18R406	Avionics	T	-	3	0	0	3
22.	AER18R407	Combustion in Aerospace Vehicles	T	-	3	0	0	3
23.	AER18R408	Design of Gas Turbine Engine Components	T	-	3	0	0	3

24.	AER18R409	Helicopter Aerodynamics	T	-	3	0	0	3
25.	AER18R410	Hypersonic Aerodynamics	T	-	3	0	0	3
26.	AER18R411	Satellite Technology	T	-	3	0	0	3
27.	AER18R412	Space Mechanics	T	-	3	0	0	3
28.	AER18R413	Theory of Elasticity	T	-	3	0	0	3
29.	AER18R414	Theory of Vibrations	T	-	3	0	0	3
30.	AER18R415	Experimental Aerodynamics	T	-	3	0	0	3
31.	AER18R416	Wind Tunnel Techniques	T	-	3	0	0	3
32.	AER18R417	Experimental Stress Analysis	T	-	3	0	0	3
33.	AER18R418	Cryogenic Engineering	T	-	3	0	0	3
34.	AER18R419	Computational Fluid Dynamics	T	-	3	0	0	3
35.	AER18R420	Composite Materials and Structures	T	-	3	0	0	3

Open Electives (Engineering):

S. No.	Course Code	Course Name	L	T	P	C
1.	AER18R305	Aircraft Engine Repair and maintenance	3	0	0	3
2.	AER18R306	Aircraft Rules and Regulations CAR I & II	3	0	0	3
3.	AER18R402	UAV System Design	3	0	0	3
4.	AER18R405	Airframe Repair and maintenance	3	0	0	3

5.	AER18R411	Satellite Technology	3	0	0	3
6.	AER18R412	Space Mechanics	3	0	0	3

Humanities Electives:

S. No.	Course Code	Course Name	Course Nature	L	T	P	C
1	HSS18R001	Management Concepts and Techniques	T	3	0	0	3
2	HSS18R002	Marketing Management	T	3	0	0	3
3	HSS18R003	Organizational Psychology	T	3	0	0	3
4	HSS18R004	Project Management	T	3	0	0	3
5	HSS18R005	Stress Management and Coping Strategies	T	3	0	0	3
6	HSS18R006	Engineering Economics	T	3	0	0	3
7	HSS18R007	Human Resource Management and Labor Law	T	3	0	0	3
8	HSS18R008	Entrepreneurship Development	T	3	0	0	3
9	HSS18R009	Cost Analysis and Control	T	3	0	0	3
10	HSS18R010	Product Design and Development	T	3	0	0	3
11	HSS17R011	Business Process Reengineering	T	3	0	0	3
12	HSS17R012	Political Economy	T	3	0	0	3
13	HSS17R013	Professional Ethics	T	3	0	0	3
14	HSS17R014	Operations Research	T	3	0	0	3
15	HSS17R015	Total Quality Management	T	3	0	0	3

One Credit Courses:

S. No	Course Code	Course Name	Course Nature	Pre-requisite	L	T	P	C
1.	AER18R391	Unmanned Aircraft systems	T	-	3	0	0	1
2.	AER18R392	Solid Rocket Propulsion	T	-	3	0	0	1
3.	AER18R393	Aerodynamics	T	-	3	0	0	1

Open Electives (Basic Science and Mathematics):

S. No.	Course Code	Course Name	Course Type	Pre-requisite	L	T	P	C
1.	OEE18R003	Mathematical Biology	T	-	3	0	0	3
2.	OEE18R004	Mathematical Modelling	T	-	3	0	0	3
3.	OEE18R005	Combinatorics	T	-	3	0	0	3
4.	OEE18R006	Industrial Chemistry for Engineers	T	-	3	0	0	3
5.	OEE18R008	Photonics and Optoelectronic Devices	T	-	3	0	0	3
6.	OEE18R009	Laser Technology	T	-	3	0	0	3

BASIC SCIENCES AND MATHEMATICS

PHY18R183	Oscillations, Waves and optics	L	T	P	C
Pre – Requisites	Nil	3	1	2	5
Course Category	Basic Science and Mathematics				
Course Type	Integrated Course				

Course Objective:

- To provide the students a firm understanding of the basics of Electricity and Magnetism.
- To introduce the students, the application of Electricity and Magnetism and Electromagnetism

Course Outcomes:

After completing this course, the student will be able to:

CO1: To learn the concepts of simple harmonic motion, damped and forced simple harmonic oscillators.
CO2: Understand the nature of transverse and longitudinal waves in one dimension and dispersion
CO3: Understand the basics of geometric optics and light as an electromagnetic wave.
CO4: Apply the concepts of interference and diffraction in optical instruments.
CO5: Gain the knowledge about different types of lasers and their applications

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	1		1						3		
CO2	3	2	2	1									3		
CO3	3	3	2	2	2	1	1		2		1		3	2	
CO4	3	2	2	1									3		
CO5	3	3	2	2	2	1	1		2	2	1		3	2	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Harmonic oscillators

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, forced mechanical and electrical oscillators, electrical and mechanical impedance, power absorbed by oscillator.

UNIT 2

Wave equations

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

UNIT 3

Light and geometrical optics

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Lenses and optical instruments based on them, and the matrix method.

UNIT 4

Wave optics

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Farunhofer diffraction from a single slit, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

UNIT 5

Lasers

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (CO_2), solid-state lasers (Nd-YAG),;semiconductor laser(Homo junction); Properties of laser beams, laser speckles, applications of lasers.

Text Books:

1. Ian G. Main, vibrations and waves in physics, Cambridge University Press, 3rd edition, 2012.
2. A. Ghatak, Optics, Tata McGraw-hill, 6th edition, 2016

References:

1. H.J. Pain, The physics of vibrations and waves, Wiley, 6th edition, 2005.
2. Brijlal and subrahmanyam, A text book of optics, 25th Edition, S. Chand, 2016.
3. O. Svelto, Principles of Lasers, 5th edition, Springer, 2010.

List of Experiments:

1. Sonometer - Determination of frequency of tuning fork.
2. Melde's string - Determination of frequency of tuning fork.
3. Spectrometer – Determination of wavelength of Hg source using grating.
4. Spectrometer - Determination of dispersive power of a prism.
5. Determination of wavelength of laser light and particle size using grating.
6. Determination of Radius of curvature of convex lens using Newton's rings.
7. Determination of Refractive Index of given liquid using Newton's rings.
8. Determination of thickness of given thin wire by Air wedge method.
9. Determination of wavelength of laser source using Michelson interferometer.
10. Determination of the thickness of thin wire using laser beam
11. Determination of acceptance angle and numerical aperture of the fibre using Laser

CHY18R181	CHEMISTRY	L	T	P	C
Pre – Requisites	Nil	3	1	2	5
Course Category	Basic Science and Mathematics				
Course Type	Integrated Course				

Course Objective:

Introducing the fundamental concepts and applications of Chemistry to the engineering students to understand, analyze and apply the same to complex technical issues.

Course Topics:

UNIT 1

Atomic and Molecular Structure

Schrodinger wave equation:Derivation of time independent Schrodinger wave equation, Representation of Schrodinger wave equation in polar coordinates - Radial distribution function graphs of s, p, d and f orbitals. Molecular Orbital Theory:MOT concept, MO diagrams of homo-nuclear diatomic molecules (hydrogen, nitrogen and oxygen) and hetero-nuclear diatomic molecules (carbon monoxide and nitric oxide). Crystal field theory:CFT concept, weak and strong ligands, energy level diagrams of transition metal ions (Fe^{2+}& Fe^{3+}) in octahedral and tetrahedral complexes and their magnetic properties. Intermolecular forces - Ionic, dipolar and van der Waals interactions.

UNIT 2

Periodic Properties

Effective nuclear charge - Factors affecting effective nuclear charge: Penetration or shielding of orbitals - Variation of s, p, d and f orbital energies of atoms in the periodic table - Aufbau principle(Building-up principle)**:** Application of Aufbau principle in writing electronic configuration, Deviation from Aufbau principle - Periodicity of properties in a periodic table - Periodic properties: Atomic and ionic sizes, ionization energies, electron affinity and electronegativity - Variation of periodic properties in the periodic table - Hard soft acids and bases: Concept and examples.

UNIT 3

Free Energy and Chemical Equilibria

Thermodynamic functions:Definition and mathematical expression for Work, Energy, Enthalpy, Entropy and Free energy - Nernst equation:Derivation, apply Nernst equation to determine of solubility product, pH (glass electrode). Potentiometric titrations: Acid-Base, Redox and precipitation reaction - Water analysis:Hardness by EDTA method and chloride ion by Argentomentric method - Corrosion: Definition, types (dry & wet) and mechanism. and control of Dry and Wet corrosion

UNIT 4

Organic Reactions

Nucleophilic substitution reactions: Definition, types and examples of nucleophile, Compare nucleophilicity and basicity of a nuceophile - Types of nucleophilic substitution (case RX and ArX): Mechanism of S_N1, S_N2, S_Ni and Benzyne. Electrophilic substitution reactions: Definition, types and examples of electrophile - Electrophilic substitution reactions of hydrocarbons:

Halogenation, sulphonation, nitration. Friedel crafts alkylation and acylation reaction. Nucleophilic addition reactions (case aldehydes and ketones):Polarity of C=O bond. General mechanism of nucleophilic addition reactions on aldehydes and ketones: HCN, HOH, ROH and $NaHSO_3$ addition. Electrophilic addition reactions (case alkenes):General mechanism of electrophilic addition reactions on alkene - Addition of HBr [Markownikoff& Anti-Markownikoff (peroxide effect)] - Addition of alkene (polymerization of ethylene). Elimination reactions: Types of elimination reactions (case alkyl halides): Dehydrohalogenation of alkyl halides - E_1 and E_2 mechanism - Dehydration of alcohols to alkene and ethers. Greener synthesis of drug molecules (Aspirin and Ibuprofen)

UNIT 5

Stereochemistry & Spectroscopic Techniques

Stereochemistry - Definition with examples: Geometrical isomers (alkene) and stereoisomers, symmetry, chirality, enantiomers, diastereomers, meso and racemic mixture. Representation of 3D structures: Wedge formula, Fischer projections, Newmann and Sawhorse formula (upto 2 carbons) - Conformational analysis: Ethane, butane and cyclohexane - Configurational analysis: Rules of RS nomenclature and application of RS nomenclature to molecules containing one chiral centre. Electronic spectroscopy:Principle, instrumentation, selection rules and medicinal application of fluorescence spectroscopy. Nuclear magnetic resonance spectroscopy (^{1}H-NMR): Principle, instrumentation, chemical shift, coupling constant and application (structural identification of the compound C_3H_6O from ^{1}H-NMR data). X-ray diffraction:Principle, instrumentation and applications X-ray diffraction.

Text Books:

1. Engineering Chemistry, 2nd Edition, Wiley India (P) Ltd., 2018.
2. Stereochemistry of Organic Compounds, Ernest L. Eliel, Samuel H. Wilen Student edition, Wiley India (P) Ltd., 2018.
3. University Chemistry, by B. M. Mahan and R.J.Mayers, Pearson Publishers, 11th Edition, Noida, 2018.
4. Chemistry Laboratory Manual, Department of Chemistry, Kalasalingam University, 2018

References:

1. Fundamentals of Molecular Spectroscopy, by C. N. Banwell and E.M. McCash, Tata McGraw-Hill Publishers, 4th Edition, New Delhi, 2008.
2. Physical Chemistry, by P. W. Atkins and J.D. Paula, W H Freeman & Co Publishers, 10th Edition, 2014.
3. Modern Inorganic Chemistry, R. D. Madan, 4th Edition S. Chand & Company Ltd., 2009.
4. Organic Chemistry, Paula Y. Bruice, 7th Edition, Pearson (Dorling Kindersley India (P) Ltd.) 2014.
5. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M. S. Pathania, 47th Edition, Vishal Publishing Co., 2018.
6. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, 8th Edition, Wiley India (P) Ltd., 2010.

List of Experiments:

1. Determination of Viscosity by Ostwald Viscometer.
2. Determination of surface tension by stalagmometer.
3. Adsorption of acetic acid by charcoal.
4. Determination of chloride content of water.
5. Estimation of hardness of water by EDTA method.
6. Determination of the rate constant of a reaction
7. Thin layer chromatography.
8. Determination of the partition coefficient of a substance between two immiscible liquids
9. Determination of Saponification /acid value of oil.
10. Preparation of Aspirin
11. Potentiometric titration of strong acid vs strong base.
12. Potentiometric titration of weak acid vs strong base.
13. Determination of cell constant and conductance of solutions.

MAT18R101	Calculus and Linear Algebra	L	T	P	C
Pre – Requisites	Nil	4	0	0	4
Course Category	Basic Science and Mathematics				
Course Type	Theory				

Course Objective:

To enable the students to acquire knowledge and skills in basic components of calculus, to handle the situations involving multivariable calculus, and to diagonalize a symmetric matrix using eigenvalues and eigenvectors.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Know the fundamental theorems such as Rolle's theorem, Mean value theorem, Taylor's theorem and its applications.
CO2: Understand the basic concepts of limit, continuity, derivative, partial derivative and total derivative and its applications.
CO3: Solve the real world problems using differentiation and integration.
CO4: Understand the concepts of sequence, convergent of sequences, series and testing of convergent of series using different methods.
CO5: Find the solution of simultaneous linear equations using matrices and to find the eigen values and eigen vectors of a matrix, Cayley-Hamilon theorem and orthogonal transformations.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3											3		
CO4	3	1											3		
CO5	3	2											3		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Calculus

Rolle's Theorem- Mean value theorems - Taylor's and Maclaurin theorems with remainders - indeterminate forms and L'Hospital's rule - Maxima and minima.

UNIT 2

Multivariable Calculus (Differentiation)

Limit, continuity and partial derivatives - directional derivatives - total derivative - Maxima, minima and saddle points - Method of Lagrange multipliers.

UNIT 3

Calculus (Applications)

Curvature (Cartesian coordinates) - Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions

UNIT 4

Sequences and series

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions

UNIT 5

Matrices

System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Cayley-Hamilton Theorem - Diagonalization of matrices - Orthogonal transformation- Reduction of Quadratic form to Canonical form

Text Books:

1. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2015

References:

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 10th Edn., 2001.
2. Ramana B. V., Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
3. Veerarajan,T., Engineering Mathematics (For First Year), Tata McGraw-Hill publishing company Limited, 2008.

MAT18R102	Multiple Integration, Ordinary Differential Equations and Complex Variable	L	T	P	C
Pre – Requisites	Nil	4	0	0	4
Course Category	Basic Science and Mathematics				
Course Type	Theory				

Course Objective:

To enable the students to understand the concepts of multiple integrations, their applications, and to handle analytic functions on complex plane and perform complex integration.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Understand the concepts of double and triple integral and its applications.
CO2: Know about the applications of double and triple integral in vector calculus.
CO3: Know the methods of solving differential equations of first and second orders.
CO4: Understand the concepts of analytic functions, conformal mappings and bilinear transformations.
CO5: Understand the concepts of singularity, residues and evaluation of certain improper integrals.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3													
CO2	3	2													
CO3	3	2			1										
CO4		3											2		
CO5		2													

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Multivariable Calculus (Integration)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volume; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds

UNIT 2

Integral theorems

Gradient, curl and divergence. Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes

UNIT 3

Ordinary differential equations

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equations

UNIT 4

Complex Variable – Differentiation

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties

UNIT 5

Complex Variable – Integration

Contour integrals, Cauchy Integral formula (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (Integration around small semicircles and rectangular contours).

Text Books:

1. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2015.

References:

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 10th Edn., 2001
2. Ramana B. V., Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition 2005.
3. Veerarajan,T., Engineering Mathematics (For First Year), Tata McGraw-Hill publishing company Limited, 2008.

MAT18R203	Partial Differential equations, Probability and Statistics	L	T	P	C
Pre – Requisites	Nil	4	0	0	4
Course Category	Basic Science and Mathematics				
Course Type	Theory				

Course Objective:

To enable the students to solve the partial differential equations and to apply them, to understand the concepts of probability and statistics, and to solve real world problems using statistical methods.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Know the method of solving first and second order partial differential equations.

CO2: Classify the second order partial differential equations and to know about solving of initial and boundary value problems.

CO3: Understand the concepts of probability, random variable, probability density functions, probability mass function, cumulative distributions and expectation.

CO4: Know about standard distributions such as binomial, poisson and normal distributions and their applications.

CO5: Evaluate moments, skewness and kurtosis for standard distributions and know about correlation and regressions.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2													
CO2		3													
CO3	3														
CO4		2		2									2		
CO5	3														

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Partial Differential Equations

First order partial differential equations, solutions of first order linear and non-linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method.

UNIT 2

Applications of Partial Differential Equations

Flows, vibrations and diffusions, second-order linear equations and their classification, Initial and boundary conditions, solution of the wave equation and diffusion equation by the method of

separation of variables, The Laplacian in plane, cylindrical and spherical polar coordinates and solutions.

UNIT 3

Basic Probability and Random Variables

Axiomatic definition of Probability - Conditional probability – Independent events - Total probability – Bayes theorem - Random variables – Discrete random variable - Probability mass function – Continuous random variable - Probability density functions – Cumulative distribution function-Properties- Expectation.

UNIT 4

Standard Distributions and Bivariate Distributions

Binomial, Poisson, Uniform, Exponential and Normal distributions and their properties. Two dimensional random variables – Joint probability density function – Cumulative distribution function – Marginal density function

UNIT 5

Statistics

Moments, skewness and Kurtosis - evaluation of statistical parameters for Binomial, Poisson and Normal distributions, Correlation and regression – Rank correlation- Curve fitting by the method of least squares- fitting of straight lines and second degree parabolas.

Text Books:

1. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
2. Veerarajan T,Probability,Statistics and Random process, Fourth edition, Tata McGraw-Hill Education(India) Pvt. Ltd., 2016.

References:

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 10th Edn., 2001.
2. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition, 5th Reprint 2004.

BIT18R101	BIOLOGY FOR ENGINEERS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Basic Science and Mathematics				
Course Type	Theory				

Course Outcomes:

After completing this course, the student will be able to:

CO1: Describe the fundamentals of cell structure and cell cycle.
CO2: Understand the classification and functions of biomolecules
CO3: Elaborate the basic cellular mechanisms such as replication, transcription and translation
CO4: Describe the underlying concepts of infection and immunity
CO5: Explain various applications of biology.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1		1	2										1
CO2	3		2	2	2								1		
CO3	3		2	2											
CO4	3	1		2	2									2	
CO5															

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION

Fundamental difference between science and engineering- comparison between eye and camera, Bird flying and aircraft; major discoveries in biology- ; Classification based on: Cellularity- Unicellular and Multicellular; Ultra structure - prokaryotes and eukaryotes; three major kingdoms of life; Cell structure, intracellular organelles and their functions, comparison of plant and animal cells- Overview of Cell cycle and cell division

UNIT 2

BIOMOLECULES

Chemistry of biomolecules: Carbohydrates, Lipids, Proteins; classification of amino acids; classification of proteins based on structure and functions; Nucleic acids -types, structure and function of DNA and RNA

UNIT 3

GENES TO PROTEINS

Gene, Genome and chromosome; Central dogma of molecular biology; Classical experiments of DNA: Griffith and, Avery, McCarty and MacLeod, Meselson and Stahl - DNA replication, Transcription and Translation

UNIT 4

MICROBIOLOGY

Microscopy; Microbes as infectious agents - malaria, tuberculosis, typhoid, polio, dengue, AIDS;; cultivation of bacteria. Immunity - innate and acquired immunity - organs and cells of the immune system - classification of antibodies - types of T cells - transplantation, autoimmunity overview

UNIT 5

APPLICATIONS OF BIOLOGY

Healthcare-antibiotics, vaccines, monoclonal antibodies, insulin and interferons; Beneficial bacteria - probiotic bacteria, nitrogen fixing bacteria, fermentation and fermented foods and products Environmental - waste water treatment, bioremediation; Biomaterials and biopolymers for medical and environmental applications; Biosensors;

Text Books:

1. De Robertis, E.D.P. and De Robertis, E.M.F. - Cell and Molecular Biology- Lippincott Williams & Wilkins- Philadelphia- USA- 8th Edition- 2010.
2. Voet, D., Voet, G., - Biochemistry - John Wiley and Sons, Singapore - 3rd Edition- 2001.
3. Pelczar MJ, Chan ECS and Krieg NR - Microbiology - Tata McGraw Hill, India- 7th Edition- 2010

References:

1. Friefelder. D. -Molecular Biology- McGraw-Hill Companies- New York, USA- 5th Edition- 2013.

HUMANITIES AND SOCIAL SCIENCES

HSS18R151	ENGLISH FOR TECHNICAL COMMUNICATION	L	T	P	C
Pre – Requisites	Nil	2	0	2	3
Course Category	Humanities and Social Sciences				
Course Type	Theory with Practical Component				

Course Topics:

UNIT 1

VOCABULARY BUILDING

1.1. The concept of word formation
1.2. Root words from foreign languages and their use in English
1.3. Prefixes and suffixes; word derivatives using them
1.4. Synonyms, Antonyms and standard Abbreviations

UNIT 2

BASIC WRITING SKILLS

2.1. Sentence structures
2.2. Use of phrases and clauses in sentences
2.3. Creating Coherence
2.4. Techniques for Writing Precisely

UNIT 3

IDENTIFYING COMMON ERRORS IN WRITING

3.1. Tenses
3.2. Subject – verb agreement
3.3. Noun –Pronoun Agreement
3.4. Verbs – Transitive, Intransitive
3.5. Misplaced Modifiers
3.6. Articles
3.7. Prepositions
3.8. Redundancies and Clichés
3.9. Direct, Indirect speech
3.10. Infinitives, Gerunds
3.11. Comparison of adjectives
Experiment: Narrating events /stories

UNIT 4

NATURE AND STYLE OF SENSIBLE WRITING

4.1. Describing
4.2. Defining
4.3. Classifying
4.4. Providing examples or evidence
4.5. Writing introduction or conclusion

UNIT 5

WRITING PRACTICES

5.1. Comprehension
5.2. Precis writing
5.3. Essay writing
5.4. Letter writing
5.5. Instructions
5.6. Paragraph development

UNIT 6

ORAL COMMUNICATION

6.1. Listening comprehension
6.2. Pronunciation, intonation, stress and rhythm
6.3. Common everyday situations: Conversations and dialogues
6.4. Interviews
6.5. I Formal presentations

HSS18R101	SOFT SKILLS - I	L	T	P	C
Pre – Requisites	Nil	3	0	0	1
Course Category	Humanities and Social Sciences				
Course Type	Theory				

Sl. No.	Course	Module	Topics Covered	No: of Hrs.
1			Parts of Speech	
2			Articles	
3			Nouns	
4			Adjectives	
5			Verbs	
6			Adverbs	
7			Prepositions	
8			Conjunctions	
9			Past Tense	
10			Present Tense	
11			Future Tense	
12			Special Cases	
13		Matching Blocks	Subject Verb agreement	
14			Modals	
15			Question Tags	
16			Concise Cogent Communication	2
17			Active Listening	2
18			Interact Interpret Respond	2
19		Expositions and discussions	JAM and Extempore-JAM and Extempore- BIKER B {Extempore}- Six Thinking Hats- JAM	2
20			Finding Errors Phrase substitution	2
21			Vocabulary	2
22			Idioms and Phrases; Collocations	2
23			Fill in the blanks Sentence Completion	2
24			Parajumbles/Jumbled Sentences	2
25			Cloze Passage; Theme Detection	2
26			Reading Comprehension	2

HSS18R102	SOFT SKILLS - II	L	T	P	C
Pre – Requisites	Nil	3	0	0	1
Course Category	Humanities and Social Sciences				
Course Type	Theory				

Sl. No.	Course	Module	Topics Covered	No: of Hrs
1		Quantitative	Number Theory- Real numbers, Divisibility, HCF and LCM, Remainder theorem, last digit, factorials, recurring decimals	2
2		Quantitative	Percentages, Profit & Loss, Discount	2
3		Quantitative	Ratio, Proportion, Allegation, Mixture, Partnership	2
4		Quantitative	Time, Speed, Distance, Trains, Boats and streams	2
5		Quantitative	Age Problem, Word Problem, Averages	2
6		Quantitative	Time & Work, pipes and cisterns	2
7		Quantitative	Mensuration 2D,Mensuration 3D, Interest calculations	2
8		Quantitative	Algebra, Clocks & Calendar	2
9		Quantitative	Probability, Permutation & Combination	2
10		Reasoning	Blood relations, Figure series	2
11		Reasoning	Series completion, cubes	2
12		Reasoning	Coding decoding, Alphabet test	2
13		Reasoning	Puzzles , Analogies	2
14		Reasoning	Syllogisms, Directions	2
15		Reasoning	Odd man out, Seating problems	2

HSS18R201	SOFT SKILLS - I	L	T	P	C
Pre – Requisites	Nil	3	0	0	1
Course Category	Humanities and Social Sciences				
Course Type	Theory				

Sl. No.	Course	Module	Topics Covered	No: of Hrs
1			Structure	2
2			Develop and Edit	2
3			Refine and Deliver	2
4		Writing skills	Essay Writing	2
5			Organize Content; Emphasize Key Points	2
6			Differing Opinions; Logical Conclusions	2
7			Pre Interview Preparation	2
8			Resume Preparation	2
9			Resume Based questions; Competency Based questions	2
10			Mock Interviews	2
11			Group discussions	2
12			Mock GD	2
13			Personal Accountability; Managing self	2
14			Business Ettiquette	2
15			Team Dynamics	2

BASIC ENGINEERING

EEE18R172	Basic Electrical Engineering	L	T	P	C
Pre – Requisites	Nil	3	1	2	5
Course Category	Basic Engineering				
Course Type	Integrated Course				

Course Objective:

To focus the fundamental ideas of the Electrical Engineering by providing wide exposure to the basic concepts of Electrical Engineering such as DC Circuits, AC Circuits, electrical machines, measuring instruments and electrical installations etc.

Course Outcomes:

After completing this course, the student will be able to:

CO1: To Apply basic laws of electricity in DC Circuits
CO2: To Apply basic laws of electricity in AC Circuits
CO3: To study the working principles of dc Machines and Transformers.
CO4: To study and working principle of AC Machines
CO5: To study the basic components of Low Voltage Electrical Installations

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3		3									3	3	
CO2	2	1											3	2	
CO3	3		2										3		
CO4	3												3		
CO5			3										3	3	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Series and Parallel circuits.Kirchoff current and voltage laws, analysis of simple dc circuits-Mesh and Nodal methods. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT 2

AC CIRCUITS

Representation of sinusoidal waveforms, RMS and Average values - form and peak factors, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT 3

DC MACHINES AND TRANSFORMERS

Construction and working principle of DC Generator and DC Motor and its emf equations- related problems. Transformer – construction, working and types- ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.

UNIT 4

AC MACHINES

Constructional details - Principle of operation - Torque-slip characteristics - Starting torque - Relation between torque and slip - Losses and efficiency. Types of single phase induction motor-construction and working of alternators

UNIT 5

ELECTRICAL INSTALLATIONS

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery Backup

Text Books:

1.V.K. Mehta, “Principles of Electrical Engineering and Electronics”, S. Chand & Company Ltd, 2012
2.Kothari D P and Nagrath I J, "Basic Electrical Engineering", McGraw Hill, 2009.
3.Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997.
4.T. Thyagarajan, “Fundamentals of Electrical and Electronics Engineering”, SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, 2015.

References:

1. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill,2006.
2. Shantha kumar S.R.J, Basic Mechanical Engineering, Third Revised Edition (Reprint 2009), Anuradha Publications, Kumbakonam, 1999.
3. Rajput R. K., Basic Mechanical Engineering, Fourth edition, Tata McGraw Hill Publishing Co., New Delhi, 2007.

LIST OF EXPERIMENTS:

1. Verification of Kirchoff’s Laws.
2. Verification of AC voltage measurements
3. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C Circuits.
4. Demonstration of DC Motor
5. Demonstration of Transformer
6. Load test on three phase transformer
7. Open circuit and short circuit tests on single phase transformer
8. Torque Speed Characteristic of separately excited dc motor.
9. Demonstration of Induction Motor
10. Load test on three-phase squirrel cage induction motor.
11. Study basic electrical installation components for LT switchgear.

MEC18R151	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C
Pre – Requisites	Nil	3	0	2	3
Course Category	Basic Engineering				
Course Type	Theory with Practical Components				

Course Objective:

This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products, Demonstrate skills in interpreting, and producing engineering drawings accurately and to give exposure to national standards relating to engineering drawing

Course Outcomes:

After completing this course, the student will be able to:

CO1: Create the projection of points and lines
CO2: Build the planes and solid objects
CO3: Illustrate the principles of sectioning of prisms, pyramids etc.
CO4: Develop surfaces of solids.
CO5: Apply orthographic and isometric projections.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		2										2	1	
CO2		3			2							3	3	2	
CO3	2		3										3	2	
CO4	1	2										1	3	2	
CO5	3		3									1	3	2	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Projection of Points and Straight Lines

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning and scales - Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations

UNIT 2

Projection of Planes and Solids

Projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes-Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method

UNIT 3

Section of Solids

Section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

UNIT 4

Development of Surfaces

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones

UNIT 5

Orthographic and Isometric Projection

Orthographic principles – missing view - free hand sketching in first angle projection from pictorial views. Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Text Books:

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, McGraw-Hill, 2008.
2. N.S. Parthasarathy, Vela Murali, Engineering Drawing, Oxford University Press, 2015.

References:

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson 2009
2. Natarajan, K.V., A Text Book of Engineering Graphics, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
3. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 53trd Edition, 2016.
4. Luzadder and Duff, “Fundamentals of Engineering Drawing”, Prentice Hall of India Pvt. Ltd., 2009.
5. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2009

Practical Modules:

1. Construction of conic sections using CAD software
2. Construction of simple planes using exclusive commands like extend, trim etc.,
3. Construction of 3D model – solids and sectional views
4. Generating 2D orthographic blue prints from 3D part models
5. Vectorization of simple building plan and elevation

MEC18R211	ENGINEERING MECHANICS	L	T	P	C
Pre – Requisites	Nil	3	1	0	4
Course Category	Basic Engineering				
Course Type	Theory				

Course Objective:

• To understand the vectorial and scalar representation of forces and moments.
• To apply static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions.
• To comprehend the effect of friction on equilibrium.
• To understand the properties of surfaces and solids
• To write the dynamic equilibrium equation

Course Outcomes:

After completing this course, the student will be able to:
CO1: Explain the vectorial and scalar representation of forces and moments
CO2: Apply static equilibrium of particles and rigid bodies both in two dimensions and in three dimensions.
CO3: Contrast the effect of friction on equilibrium
CO4: Illustrate the importance of properties of surfaces and solids
CO5: Demonstrate the dynamic equilibrium equation

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1										2		
CO2	3	2	1										2		
CO3	3	2	1										1		
CO4	2	2	2										1		
CO5	2		1												

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Statics of Particles

Six Fundamental principles and concepts - vector algebra- basics, concurrent and non-concurrent coplanar forces - resultant and resolution of forces- static equilibrium of particles in 2-D and 3-D

UNIT 2

Static of Rigid Bodies

Moment about point and about axis - Varignon's theorem - Static equilibrium of rigid body in 2-D and 3-D, free body diagram, supports and reactions – Problem formulation concept in 2-D and 3-D-Ball and socket joint

UNIT 3

Friction

Frictional forces- Types- laws of dry friction- simple contact friction - Sliding block, wedges, ladder friction - rolling resistance –Examples

UNIT 4

Properties of Surfaces and Solids

Centre of gravity – T section, I section- Centroids of lines - areas, volumes, composite bodies, - Area moment of Inertia – T section, I section-principal moment of inertia

UNIT 5

Dynamics of Particles

Introduction – Kinematics of particles – Displacements, velocity and acceleration, their relationship - Equations of motions– Rectilinear motions - relative motion – Curvilinear motion – Kinetics of particles - Newton's second law – Equations of motion – rectangular components – Work Energy equation of particles.

Text Books:

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, McGraw Hill, Tenth Edition in SI units

References:

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, Seventh Edition.
2. Irving, H., Shames, Engineering Mechanics, Statics and Dynamics, Prentice Hall of India Ltd., Fourth Edition

CSE18R181	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
Pre – Requisites	Nil	3	0	2	3
Course Category	Basic Engineering				
Course Type	Integrated Course				

Course Objective:

To make the students to understand the basic concepts of programming language, rules to be followed while writing a C program and how to compile and execute C programs

Course Outcomes:

After completing this course, the student will be able to:

CO1: Interpret the basic programming concepts and syntax of C language
CO2: Solve simple problems using C arrays and strings.
CO3: Apply modular programming concept of C to solve given problem
CO4: Develop efficient code using memory allocation techniques.
CO5: Create user defined data types and files to solve real world problems

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3		3					2	2					
CO2		3		3		2	2								
CO3	3	3			2		3	3	2		2	2			
CO4											3	3			
CO5		3		3			2								

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Basics of C

Structure of C program - concept of a variable-Data type in C - Program Statement - Declaration – Tokens - Operators and expressions - Type Conversion - Input and output - Control statements: Selection - Iteration - Goto statement - Special control statement-Nested loops

UNIT 2

Arrays and Strings

Introduction - One dimensional and two dimensional arrays – Declaration of arrays - Initializing and Accessing array elements – Strings: One dimensional character arrays - Declaration and String Initialization - String Manipulation - Multidimensional Arrays - Arrays of Strings

UNIT 3

Functions

Introduction - Concept of function - Using Functions - Call by Value Mechanisms -Working with Functions - Passing Arrays to Functions - Scope and Extend - Storage Classes - Inline Functions

– Sorting Using Functions: Bubble sort - Searching: Linear and Binary Search – Recursive Functions

UNIT 4

Pointers

Introduction - Address of operands – Pointer: Declaration and Initialization - Arrays and Pointers - Pointers and Strings - Pointer Arithmetic - Pointers to Pointers - Array of Pointers - Pointer to Array - Dynamic Memory Allocation (DMA)

UNIT 5

User Defined Data Types and Files

Introduction – Structures - Declaration and Initialization of Structures - Arrays within Structure - Structure and Pointers - Structures and Functions – Union - Enumeration types - Using Files in C - Working with Text Files - Working with binary files

Text Books:

1. PradipDey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, Oxford University Press, 2nd Edition, 2013
2. Byron S. Gottfried, “Programming with C”, Second Edition, McGraw Hill, 2006

References:

1. Brian W. Kerninghan and Dennis M. Richie, “The C Programming language”, Pearson Education, 2005.
2. Johnsonbaugh R. and Kalin M, “Applications Programming in ANSI C”, Third Edition, Pearson Education, 2003.
3. E. Balagurusamy, “Programming in ANSI C”, Fourth Edition, McGraw Hill 2008

List of Experiments:

1. Programs using control and looping statements.
2. Programs using 1-D and 2-D arrays.
3. Programs using string handling functions.
4. Programs using functions with various parameter passing mechanisms.
5. Programs using recursive functions.
6. Programs using pointers and dynamic memory allocation functions for 1-D and 2-D arrays.
7. Programs to create user defined data like structures and unions to represent real world problems
8. Programs for creating text files to store and manipulate data

MEC17R152	ENGINEERING PRACTICE	L	T	P	C
Pre – Requisites	Nil	3	0	2	3
Course Category	Basic Engineering				
Course Type	Theory with Practical Component				

Course Objective:

To make the student familiarize with the workshop process and to gain some basic knowledge about the carpentry, fitting and etc

Course Outcomes:

After completing this course, the student will be able to:

CO1: Develop various joints in wood and understand their applications in typical wooden products
CO2: Construct simple mating profiles with saw process and perform various machining operations like drilling, tapping, etc
CO3: Build pipe connections with mixed pipe materials and different joining components
CO4: Examine the LPG stove and perform troubleshooting and cleaning operation
CO5: Inspect two-wheeler and four-wheeler for repairs and perform the basic diagnosing process

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2				2										
CO2	2				1										
CO3	2				2										
CO4				2				1							
CO5					1										

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

List of Experiments:

Carpentry

Carpentry tools - practice in marking, sawing, planning and chiselling – making simple joints: lap joint, T-joint, dovetail joint, mortise and tenon joint

Fitting

Fitting tools - practice in marking, filing, punching, hacksawing - fitting to size and drilling - making of simple mating profiles: V, square, dovetail, half round joints

Sheet Metal and Drilling

Study of press, die and tools - sheet metal layout - development of lateral surfaces -simple exercises: blanking, forming, bending and flanging, Drilling and tapping in drilling machines

Plumbing

Basic pipe connections-Mixed Pipe material connection-Pipe connection with different joining

LPG Stove

Troubleshooting LPG stoves -Practice in dismantling and cleaning procedures

UPS Battery Maintenance

Batteries-Lead acid battery cleaning and acid topping up- Testing with hydrometer, Voltmeter.

Two-Wheeler Service

Study of engine oil types- replacement- Setting engine idle speed, Clutch ply adjustment. Air filter cleaning methods – Practice on adjusting chain tension, carburettor adjustment

Four-Wheeler Tyre Repairs

Study of Tyres – Dimensions - Diagnosing four-wheeler puncture in Tube tyres, Tubeless tyres

References:

1. Suyambazhahan S, "Engineering Practices", Eastern Economy Edition, 2013.

Lectures & videos:

Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods **(3 lectures)**
2. CNC machining, Additive manufacturing **(1 lecture)**
3. Fitting operations & power tools **(1 lecture)**
4. Carpentry **(1 lecture)**
5. Plastic moulding, glass cutting **(1 lecture)**
6. Metal casting **(1 lecture)**
7. Welding (arc welding & gas welding), brazing **(1 lecture)**

Workshop Practice:

1. Machine shop **(10 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(6 hours)**
4. Welding shop **(8 hours (Arc welding 4 hrs + gas welding 4 hrs)**
5. Casting **(8 hours)**
6. Smithy **(6 hours)**
7. Plastic Molding & Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

ECE18R222	BASIC ELECTRONIC ENGINEERING	L	T	P	C
Pre – Requisites	Nil	3	1	0	4
Course Category	Basic Engineering				
Course Type	Theory				

Course Objective:

To provide an overview of electronic device components to Mechanical engineering students

Course Outcomes:

After completing this course, the student will be able to:

CO1: Understand the principles of semiconductor devices and their applications.
CO2: Design an application using Operational amplifier.
CO3: Understand the working of timing circuits and oscillators.
CO4: Understand logic gates, flip flop as a building block of digital systems.
CO5: Learn the basics of Electronic communication system.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3		3					2	2					
CO2		3		3		2	2								
CO3	3	3			2		3	3	2		2	2			
CO4											3	3			
CO5		3		3			2								

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

SEMICONDUCTOR DEVICES AND APPLICATIONS

Introduction to P-N junction Diode and V-I characteristics, Zener diode and its characteristics, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

UNIT 2

OPERATIONAL AMPLIFIER AND ITS APPLICATIONS

Introduction to Op-Amp, CMRR, Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground, summing and difference amplifier, unity gain buffer, integrator and differentiator.

UNIT 3

TIMING CIRCUITS AND OSCILLATORS

555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator

UNIT 4

DIGITAL ELECTRONICS FUNDAMENTALS

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, multiplexers, demultiplexers, flip-flops, Block diagram of microprocessor/microcontroller and their applications.

UNIT 5

ELECTRONIC COMMUNICATION SYSTEMS

The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, Mobile communication systems: cellular concept and block diagram of GSM system

Text Books:

1. A.David Bell, “Electronic Devices and Circuits”, Edition: 5, Oxford University Press, 2008

References:

1. R P Jain, “Modern Digital Electronics”, Edition: 4, McGraw Hill, 2009.
2. Frenzel, “Communication Electronics: Principles and Applications”, Edition: 3, McGraw Hill, 2002.

PROGRAM CORE

AER18R271	STRENGTH OF MATERIALS	L	T	P	C
Pre – Requisites	Nil	3	0	2	4
Course Category	Program Core				
Course Type	Integrated Course				

Course Objective:

Students will be able to understand the concepts of deformable bodies including geometry of deformation, and material behaviour. Revelations to systematic methods of problem solving techniques. Knowledge on solving structural members subjected to the different types of loading

Course Outcomes:

After completing this course, the student will be able to:

CO1: Analysing the tensile and compressive strength in bars using various loads, testing the stresses using loads in different materials.
CO2: Evaluating the principal plane and stresses in two dimensional bodies and analyse the deformation in thin cylindrical and spherical shells.
CO3: Demonstrate the types of beams and supports, sketch the shear force and bending moment diagram in various loads and testing the deflections in various beams.
CO4: Analysing the stress distribution of shear and bending in the various section of the beams.
CO5: Illustrate the stress and deformation in circular structures due to combined bending and strain energy, testing the torsion on mild steel and designing the various types of springs

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3		2	2								3		1
CO2	3	2		2	3								3		1
CO3	3		3	3	2								3		1
CO4	3		3	2									3		1
CO5	3		2		2								3		1

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Stress, Strain and Deformation in Solids

Tension, compression and shear stresses – Hook's law – stress- ultimate stress and working stress – elastic constants and relationships between them – composite bars – temperature stresses – strain energy due to axial load – stress due to suddenly applied load and impact load.

UNIT 2

Stress and Deformation in 2D Bodies

Two dimensional state of stress at a point – normal and shear stresses on any plane, principal planes and principal stresses – graphical method – two dimensional state of strains at a point,

principal strains and their directions – stresses and deformations in thin cylinders and spherical shells due to internal pressure.

UNIT 3

Beams and Supports

Types of beams and supports – shear force and bending moment at any cross section, sketching of shear force and bending moment diagrams for cantilever, simply supported and over hanging beams for any type of loading – relationship between rates of loading – shear force and bending moment

UNIT 4

Stresses in Beams

Theory of simple bending – analysis for bending stresses – load carrying capacity of beams – proportioning sections – strain energy due to bending moment – shear stress distribution – strain energy due to transverse shear force.

UNIT 5

Torsion and Springs

Elastic theory of torsion – stresses and deformation in solid circular and hollow shafts – stepped shafts – composite shaft – stress due to combined bending and torsion– strain energy due to torsion-deformations and stresses in helical springs – design of buffer springs -leaf springs.

Text Books:

1. Popov, E.P., Engineering Mechanics of solids, Prentice Hall of India, New Delhi, 8thEdition 2014.

References:

1. Kazimi, S. M. A., Solid Mechanics, Tata McGraw Hill Book Co Ltd., 1998.
2. Rajput, Strength of Materials, S. Chand Publications, 2009.
3. Bansal, R. K., Strength of Materials, Laxmi Publications, 4th Edition, 2015

List of Experiments:

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on metal specimen
4. Hardness test on metals - Brinell and Rockwell hardness number
5. Deflection test on beams
6. Stiffness test on helical springs.
7. Corrosion test on mild steel plate.
8. Pin on disk – exercise on mild steel plate.

AER18R272	FLUID MECHANICS	L	T	P	C
Pre – Requisites	Nil	3	0	2	4
Course Category	Program Core				
Course Type	Integrated Course				

Course Objective:

To cover the basic principles and equation of fluid mechanics and to present numerous and diverse real world engineering examples to give students a feel for how fluid mechanics is applied in engineering practice

Course Outcomes:

After completing this course, the student will be able to:

CO1: Discuss the basic concepts of fluid mechanics.
CO2: Apply the conservation principles governing fluid flows.
CO3: Apply the viscous flow equations to solve the viscous problems.
CO4: Perform dimensional analysis problems.
CO5: Calculate the boundary layer parameters and aerodynamic forces on bluff bodies

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3											2	2		
CO2	2	2										2	1		
CO3	3	2	2	3								3	3		
CO4	1	3	3	2											
CO5	1	2	2												

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Basic Concepts and Properties

Properties of fluids, viscosity, thermodynamic properties, compressibility and bulk modulus, surface tension and capillarity, Pascal's law, pressure head, pressures – absolute; gauge; vacuum, pressure measurement – manometer, pressure and temperature at any point in compressible fluid, temperature lapse rate.

UNIT 2

Laws of Conservation

Lagrangian and Eulerian description of fluid flow, types of fluid flow, streamlines, pathlines, and streaklines, Continuity and Momentum equation, velocity potential function and stream function, types of motion, vortex flow, potential flow, Euler's and Bernoulli's equation - Application through various examples including flow measuring devices - Orifice meter, venturi meter, pitot tube.

UNIT 3

Viscous Flow

Laminar and turbulent flow, viscous flow through a circular pipe, viscous flow between parallel plates, kinetic energy and momentum correction factors, Pipe friction, Darcy-Weisbach equation and chezy's formula, Pipe losses, velocity defect, velocity distribution in smooth and rough pipes

UNIT 4

Dimensional Analysis and Similitude

Dimensional Analysis -, Buckingham Pi - theorem, Derivations and applications of important dimensionless numbers, basic modeling and similitude.

UNIT 5

Fluid Flow Over Bodies

Boundary layer theory - boundary layer development on a flat plate, displacement thickness, momentum thickness, Energy thickness, momentum integral equation, drag on flat plate - Nature of turbulence, Separation of flow over bodies - streamlined and bluff bodies, Lift and Drag on cylinder and Aerofoil.

Text Books:

1. Streeter, V.L., and Wylie, E.B., Fluid Mechanics, McGraw-Hill, 2010

References:

1. Kumar, K.L., Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd, New Delhi, 7th edition, 2002.
2. Vasandani, V.P., Hydraulic Machines - Theory and Design, Khanna Publishers, 11th Edition 2010.
3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi publications (P) Ltd, New Delhi, 9th edition,2010.
4. White, F.M., Fluid Mechanics, Tata McGraw-Hill, c, 5th Edition, 2003.
5. Ramamirtham, S., Fluid Mechanics and Hydraulics and Fluid Machines, DhanpatRai and Sons, Delhi, 3rd edition 1998.
6. Som, S.K., and Biswas, G., Introduction to Fluid Mechanics and Fluid Machines, Tata McGrawHill, New Delhi, 3rd Edition, 2011.

List of Experiments:

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.

AER18R201	PRINCIPLES OF FLIGHT	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Program Core				
Course Type	Theory				

Course Objective:

Understand the basic concepts of Aeronautical Engineering and current development in the field.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain the history of aircraft and development over the years
CO2: Classify the components, control systems of aircraft and its functions
CO3: Outline the basic concepts of flight and physical properties of atmosphere
CO4: Categorize the types of fuselage construction and landing gear system
CO5: Demonstrate the different types of engines and principles of rocket

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3												2		
CO2	2												3		
CO3	3												1		
CO4						2							1		
CO5	3												1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

History of flight

Balloon flight-ornithopters-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT 2

Aircraft configurations and its controls

Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation

UNIT 3

Basics of Aerodynamics

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT 4

Basics of Propulsion

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production- Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

UNIT 5

Basics of Aircraft Structures

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law- stress-strain diagrams- elastic constants-Factor of Safety.

Text Books:

1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015
2. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004

References:

1. Kermode, A.C. Flight without Formulae, Pearson Education; Eleven edition, 2011

AER18R202	AERO THERMODYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Program Core				
Course Type	Theory				

Course Objective:

Enable the students to understand the basic principles and concepts of classical thermodynamics

Course Outcomes:

After completing this course, the student will be able to:

CO1: Comprehend the basic thermodynamic systems
CO2: Infer the concepts of second law of thermodynamics and Carnot cycle.
CO3: Interpret the one dimensional fluid flow and the application of continuity equation and Rankine cycle.
CO4: Illustrate about air standard cycles and P-V diagrams of four stroke and two stroke IC engines.
CO5: Demonstrate the principles of refrigeration and air conditioning

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2										3		3
CO2	3	2	1									2	3		2
CO3	1	3	2	1								3	3		3
CO4	2		1												
CO5	2	1	1												

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

First Law of Thermodynamics

Concept of continuum-Macroscopic approach-thermodynamic systems-properties-state, path and process, quasi-static process- work and heat-zeroth law and first law of thermodynamics-internal energy-enthalpy- applications of first law of thermodynamics to closed and open system

UNIT 2

Second Law of Thermodynamics

Second law of thermodynamics-Kelvin's and Clausius statements of second law-reversibility and irreversibility-carnot theorem-carnot cycle- reversed carnot cycle- clausius inequality-concept of entropy-principle of energy-availability and unavailability-Exergy for closed and an open systems

UNIT 3

Properties of Pure Substances and Power Cycle

Properties of pure substances-Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, H-S diagrams, PVT surfaces thermodynamics properties of steam, calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and Regeneration cycle.

UNIT 4

Air Standard Cylces and IC Engines

Cycle-air standard efficiency-Otto cycle-diesel cycle- dual cycle- Brayton cycle-components of IC engines-Two stroke and four stroke cycle engine-performance of IC engine-supercharging.

UNIT 5

Refrigeration, Air Conditioning and Psychrometry

Concepts of psychrometry, Psychrometric relation and charts-processes-Refrigeration systems-Air-conditioning systems and its types- simple vapour compression system-vapour absorption system-Refrigerants.

Text Books:

1. Nag.P.K., “Engineering Thermodynamics”, McGraw Hill Education (India) Private Limited; Fifth edition ,April 2013

2. Rathakrishnan E, “Fundamentals of Engineering Thermodynamics”, Prentice Hall India, 2 revised edition 2005

3. Yunus A. Cengel and Michael A. Boles, “Thermodynamics: An Engineering Approach” McGraw-Hill Science/Engineering/Math; 7thedition 2010.

References:

1. Ramalingam K.K. “Thermodynamics”, Sci-Tech Publications, 2006

2. Holman.J.P., “Thermodynamics”, 3rd Ed. McGraw-Hill, 2007.

3. Venwylen and Sontag, “Classical Thermodynamics”, Wiley Eastern, 1987

4. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.

5. Merala C, Pother, Craig W, Somerton, “Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004

AER18R203	KINEMATICS AND DYNAMICS OF MACHINES	L	T	P	C
Pre – Requisites	MEC17R103	3	1	0	3
Course Category	Program Core				
Course Type	Theory				

Course Objective:

To expose the students the different mechanisms, their method of working, forces involved and consequent vibration during working.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Relate the various mechanisms and degrees of freedom
CO2: Illustrate the effects of centrifugal and initial tension in drives and condition for maximum power transmission.
CO3: Determine the speed and torque of the various types of gear geometry and also the follower motions of cam profile.
CO4: Comprehend the concepts of balancing in rotating mass and balancing of reciprocating mass
CO5: Examine the free, forced and damped vibrations and its force transmitted to supports

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		2									2	3		
CO2	2		3										1	1	
CO3	2		3										1		
CO4	2			1									1		
CO5	2												1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

MECHANISMS

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint and motion – Degrees of freedom - Slider crank – single and double – Crank rocker mechanisms – Inversions, applications – Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms

UNIT 2

FRICTION

Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – plate and cone clutch – belt (Flat and V) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

UNIT 3

GEARS AND CAMS

Gear – Types and profile – nomenclature of spur and helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – Cam – Types of cams and followers – Cam design for different follower motions

UNIT 4

VIBRATION

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

UNIT 5

BALANCING

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi cylinder engines – Governors and Gyroscopic effects.

Text Books:

1. Bansal R.K., "Theory of Machines", Laxmi Publications Pvt Ltd., New Delhi, 20th edition 2009.
2. Rattan S.S., "Theory of machines", Tata McGraw Hill publishing Co., New Delhi, 2nd edition 2011

References:

1. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory", Second Edition, Wiley Eastern Limited, 2006.
2. Malhotra D.R. and Gupta H.C , "The Theory of machines", SatyaPrakasam, Tech. India Publications, 2008.
3. Gosh A and Mallick A.K., "Theory of Machines and Mechanisms", Affiliated East West press, 2009.
4. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw Hill, 2006.

AER18R273	AERODYNAMICS - I	L	T	P	C
Pre – Requisites	AER18R272	3	0	2	4
Course Category	Program Core				
Course Type	Integrated Course				

Course Objective:

To study aerodynamic concepts and understanding the motion of air around an object enables the calculation of forces and moments acting on the object.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Relate fluid mechanics concepts with aerodynamic problems
CO2: Examine the flow over wing
CO3: Differentiate the ideal and real flows
CO4: Develop the mathematical modelling ability
CO5: Demonstrate the real time viscous flow and boundary layer behavior.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1		2		2									3	3	
CO2	2	2		2									1	1	2
CO3	1	1		1									1		
CO4	2	2		2	2								1	2	
CO5	3	2											1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

REVIEW OF BASIC FLUID MECHANICS

System and Control volume approach, substantial, local and convective derivative, Continuity, momentum and energy equations, Inviscid flow, Euler equation, incompressible Bernoulli's Equation. Circulation and Vorticity, Green's Lemma and Stoke's Theorem, Barotropic Flow, Kelvin's theorem, Streamline, Stream Function, Irrotational flow, Potential Function, Equipontential Lines, Elementary Flows and their combinations

UNIT 2

TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW

Ideal Flow over a circular cylinder, D'Alembert's Paradox, Magnus effect, KuttaJoukowski's Theorem, Starting Vortex, Kutta condition, Real flow over smooth and rough cylinder

UNIT 3

AIRFOIL THEORY

Cauchy-Riemann relations, Complex Potential, Methodology of Conformal Transformation, Kutta- Joukowski transformation and its applications, Karman Trefftz Profiles, Thin Airfoil theory and its applications.

UNIT 4

SUBSONIC WING THEORY

Vortex Filament, Biot - Savart Law, Bound Vortex and trailing Vortex, Horse Shoe Vortex, Lifting Line Theory and its limitations.

UNIT 5

INTRODUCTION TO LAMINAR AND TURBULENT FLOW

Boundary layer and boundary layer thickness, displacement thickness, momentum thickness, Energy thickness, Shape parameter, Boundary layer equations for a steady, two dimensional incompressible flow, Boundary Layer growth over a Flat plate, Critical Reynolds Number, Blasius solution, Basics of Turbulent flow, Prandtl's mixing length hypothesis, Free shear layers.

Text Books:

1. E. L. Houghton & N. B. Carruthers, "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
2. Anderson, J.D., Fundamentals of Aerodynamics, McGraw-Hill Education; 5th edition, 2010.

References:

1. Milne Thomson, L.H., Theoretical Aerodynamics, Macmillan, 1985.
2. John J Bertin., Aerodynamics for Engineers, Prentice Hall publishers6th edition, 2013.
3. Clancy, L J., Aerodynamics, Shroff publishers2006

List of Experiments:

1. Calibration of a subsonic wind tunnel
2. Pressure distribution over a smooth circular cylinder
3. Pressure distribution over a rough circular cylinder
4. Pressure distribution over a symmetric airfoil
5. Pressure distribution over a cambered airfoil

AER18R274	AIRCRAFT STRUCTURES – I	L	T	P	C
Pre – Requisites	AER18R271	3	0	2	4
Course Category	Program Core				
Course Type	Integrated Course				

Course Objective:

To Analyze and Design simple aircraft structural components.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Solve statically indeterminate structures
CO2: Make simplified analysis of aircraft structures and apply energy methods
CO3: Determine the critical buckling load of columns.
CO4: Relate failure theories with aircraft structural problems
CO5: Design the various joints for loading conditions

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	3	1										1	2	
CO2	1		2											2	
CO3	2	1	3										2		
CO4	1			3											1
CO5	1		3											2	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

ANALYSIS OF TRUSSES AND BEAMS

Plane truss analysis, plane frame analysis, analysis of a 3-D truss, analysis of continuous beams using Clapeyron's 3-moment equation.

UNIT 2

ENERGY METHODS OF ANALYSIS

Energy expression for various loadings and its application to statically determinate and indeterminate beams, trusses, frames and rings.

UNIT 3

BUCKLING OF COLUMNS

Buckling of Long column and short column- inelastic buckling- columns with different end conditions, empirical methods, the Southwell plot, use of Energy methods, imperfections in columns, stresses and deflections in a beam-column.

UNIT 4

FAILURE ANALYSIS

Failure of Ductile and brittle materials, Theories of failure and their Failure envelopes, Introduction to fatigue failure and fracture mechanics of materials

UNIT 5

DESIGN OF JOINTS

Types of joints and rivets. Failure of joints. Design of bolted joints. Stresses in bolts and nuts due to various loadings - Axial load, shear load and combined loading. Types of welded joints.Strength of welded joints for various loadings

Text Books:

1. 'Mechanics of Materials' by James M. Gere & Barry J Goodno, cengage Learning Custom Publishing; 8th edition, 2012.
2. Megson T M G, `Aircraft Structures for Engineering students' Butterworth-Heinemann publisher, 5th edition, 2012.
3. N.C. Pandya, C.S. Shah, "Elements of Machine Design", Charotar Publishing House, 15th edition, 2009.

References:

1. Donaldson, B.K., 'Analysis of Aircraft Structures - An Introduction' Cambridge University Press publishers, 2 ndedition , 2008
2. Bruhn E F, 'Analysis and Design of Flight Vehicle Structures', Tri-State Off-set Company, USA, 1985
3. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999.

List of Experiments:

1. Determination of Flexural strength of materials.
2. Deflection of Beams
3. Verification of Maxwell's Reciprocal Theorem
4. Buckling Load estimation of Slender Eccentric Columns
5. Combined bending and Torsion of a Hollow Circular Tube

AER18R275	PROPULSION- I	L	T	P	C
Pre – Requisites	Nil	3	0	2	4
Course Category	Program Core				
Course Type	Integrated Course				

Course Objective:

To study in detail about the fundamentals of aircraft propulsion. To understand the principles of operation and design of aircraft power plants.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Comprehend the working principle of gas turbine engines, thermodynamic cycles and performance characteristics of gas turbine engines
CO2: Interpret the internal flows & external characteristics near the inlets. Starting problems and different modes of operation in supersonic inlets
CO3: Classify the types and working methods in combustion chambers. The flame stabilization and flame techniques
CO4: Summarize the flow through the nozzle, choking, losses in nozzle, variable area nozzle and thrust vector control
CO5: Know the types and working principles of compressors, velocity diagrams, blade design and performance characteristics of compressor

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2												2		
CO2	1		3											1	
CO3	1	1	2											1	
CO4	1		3											1	
CO5	1	2		2										1	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FUNDAMENTALS OF GAS TURBINE ENGINES

Illustration of working of gas turbine engine – The thrust equation – Factors affecting thrust – Effect of pressure, velocity and temperature changes of air entering compressor – Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet – Performance characteristics

UNIT 2

INLETS

Internal flow and Stall in subsonic inlets – Boundary layer separation – Major features of external flow near a subsonic inlet – Relation between minimum area ratio and eternal deceleration ratio –

Diffuser performance – Supersonic inlets – Starting problem on supersonic inlets – Shock swallowing by area variation – External declaration – Models of inlet operation.

UNIT 3

COMBUSTION CHAMBERS

Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders – Numerical problems

UNIT 4

NOZZLES

Theory of flow in isentropic nozzles – Convergent nozzles and nozzle choking –Nozzle throat conditions – Nozzle efficiency – Losses in nozzles – Over expanded and under – expanded nozzles – Ejector and variable area nozzles – Interaction of nozzle flow with adjacent surfaces – Thrust reversal

UNIT 5

COMPRESSORS

Principle of operation of centrifugal compressor – Work done and pressure rise – Velocity diagrams – Diffuser vane design considerations – Concept of prewhirl – Rotation stall – Elementary theory of axial flow compressor – Velocity triangles – degree of reaction – Three dimensional – Air angle distributions for free vortex and constant reaction designs – Compressor blade design – Centrifugal and Axial compressor performance characteristics.

Text Books:

Hill, P.G. & Peterson, C.R. “Mechanics & Thermodynamics of Propulsion” Pearson education (2009

References:

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. “Gas Turbine Theory”, Pearson Education Canada; 6th edition, 2008.
2. Oates, G.C., “Aero thermodynamics of Aircraft Engine Components”, AIAA Education Series, New York, 1985.
3. “Rolls Royce Jet Engine”, Rolls Royce; 4th revised edition, 1986.
4. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”,
5. Standard Publishers & Distributors, Delhi, 2nd edition 2014.

List of Experiments:

1. Study of aircraft piston engines and gas turbine engines
2. Velocity profiles of free jets
3. Velocity profiles of wall jets
4. Wall pressure distribution in subsonic diffusers
5. Wall pressure measurements in supersonic nozzles

AER18R281	AIRCRAFT COMPONENET DRAWING LABORATORY	L	T	P	C
Pre – Requisites	Nil	1	0	3	2
Course Category	Program Core				
Course Type	Laboratory				

Course Objective:

To introduce the concept of design of basic structural components and to draft both manually and using modelling package

Course Outcomes:

After completing this course, the student will be able to:

CO1: Design the riveted lab butt joints
CO2: Design the welded and bolted joints
CO3: Design the empennage of an aircraft
CO4: Design the aircraft wing, fuselage, landing gear using design software.
CO5: Design the aircraft control system.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			3											3	
CO2			3											3	
CO3			3											3	
CO4			3											3	
CO5			3											3	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

List of Experiments:

1. Design of riveted joints (Lap joint).
2. Design of riveted joints (Butt joint with single and double straps).
3. Design of welded joints.
4. Design of bolted joints.
5. Design of empennage.
6. Computer aided modeling of typical aircraft wing.
7. Computer aided modeling of typical fuselage structure.
8. Computer aided modeling of landing gear
9. Three view diagram of a typical aircraft
10. Layout of control systems.

AER18R371	AERODYNAMICS-II	L	T	P	C
Pre – Requisites	AER18273	3	0	2	4
Course Category	Program Core				
Course Type	Integrated Course				

Course Objective:

To understand the behavior of air flow both internal and external in compressible flow regime with particular emphasis on supersonic flows

Course Outcomes:

After completing this course, the student will be able to:

CO1: Outline the fundamental aspect of compressible flow
CO2: Dissect the physics of shock and expansion waves
CO3: Solve the equations of two dimensional compressible flow
CO4: Find the factors affecting aircraft configurations
CO5: Categorize high speed flows, and flow visualization techniques

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3										2	3		
CO2	3		2	2									2		
CO3	3	2											2		
CO4	3	2											2		
CO5	3		2										1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FUNDAMENTAL ASPECTS OF COMPRESSIBLE FLOW

Compressibility, Continuity, Momentum and energy equation for steady one dimensional flow-compressible Bernoulli's equation-Calorically perfect gas, Mach Number, Speed of sound, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Static and Stagnation properties, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity.

UNIT 2

SHOCK AND EXPANSION WAVES

Normal shock relations, Prandtl's relation-Hugoniot equation, Raleigh Supersonic Pitot tube equation-Moving normal shock waves, Oblique shocks, M relation, Shock Polar, Reflection of oblique shocks, left running and right running waves-Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions, operating characteristics of Nozzles, under expansion, over expansion

UNIT 3

TWO DIMENSIONAL COMPRESSIBLE FLOW

Potential equation for 2-dimensional compressible flow, Linearization of potential equation, perturbation potential, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl-Glauert rule, Linearized supersonic flow, Method of characteristics.

UNIT 4

HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION

Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircrafts.

UNIT 5

CHARACTERIZATION OF HIGH SPEED FLOWS

Shock-Boundary layer interaction, Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels, Supersonic flow visualization, Introduction to Hypersonic Flows

Text Books:

1. Anderson, J. D, Modern Compressible Flow: With Historical Perspective McGraw-Hill Education; 3rd edition, 2002
2. Rathakrishnan. E, Gas Dynamics, Prentice-Hall of India Pvt.,Ltd, 2008.

References:

1. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982.
2. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill &Co., 1989.
3. Oosthuizen,P.H., &Carscallen,W.E., Compressible Fluid Flow, CRC Press; 2 edition (July 22, 2013)

List of Experiments:

1. Force measurements on aircraft models
2. Calibration of supersonic wind tunnels
3. Flow visualization studies in supersonic flows
4. Pressure distribution over a finite wing of symmetric aero foil sections
5. Pressure distribution over a finite wing of cambered aero foil section

AER18R372	AIRCRAFT STRUCTURES – II	L	T	P	C
Pre – Requisites	AER18R274	3	0	2	4
Course Category	Program Core				
Course Type	Integrated Course				

Course Objective:

To study the behavior of various aircraft structural components under different types of loads

Course Outcomes:

After completing this course, the student will be able to:

CO1: Determine the maximum bending stress of unsymmetrical sections
CO2: Interpret the shear center location in thin walled open section
CO3: Interpret the shear center location in thin walled closed section
CO4: Determine the buckling allowable load of aircraft skin
CO5: Analyze the aircraft wing, tail, and fuselage

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3											1		
CO2	1	2	2										1	2	
CO3	1	2	2										1	2	
CO4		2	1												1
CO5	3		2									1			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

UNSYMMETRICAL BENDING OF BEAMS

Unsymmetrical bending of beams – different methods of analysis (neutral axis method, ‘k’ method, and the principal axis method), stresses and deflections in beams under unsymmetrical bending

UNIT 2

SHEAR FLOW IN OPEN SECTIONS

Definition and expression for shear flow due to bending, shear flow in thin-walled Open sections with and without stiffening elements, torsion of thin-walled Open sections, the shear center of symmetric and unsymmetrical open sections, structural idealization

UNIT 3

SHEAR FLOW IN CLOSED SECTIONS

Shear flow due to bending and torsion in single-cell and multi-cell structures, the shear center of symmetric and unsymmetrical closed sections, effect of structural idealization, shear flow in a tapered beam, stress analysis of thin-webbed beams using Wagner’s theory

UNIT 4

BUCKLING OF PLATES

Behaviour of a rectangular plate under compression, governing equation for plate buckling, buckling analysis of sheets and stiffened panel under compression, concept of the effective sheet width, buckling due to shear and combined loading, crippling

UNIT 5

AIRCRAFT STRESS ANALYSIS

Loading and analysis of aircraft wing, fuselage, and tail unit. Use of V-n diagram for sizing the aircraft wing, fuselage, and tail unit.

Text Books:

1. Megson T M G, 'Aircraft Structures for Engineering Students', Butterworth-Heinemann; 5 edition,2012
2. Bruhn. E.H., 'Analysis and Design of Flight Vehicles Structures', Tri-state off-set company, USA, 1985
3. Howard D Curtis, 'Fundamentals of Aircraft Structural Analysis', WCB-McGraw Hill, 1997

References:

1. Rivello, R.M., Theory and Analysis of Flight Structures, McGraw Hill, 1993.
2. Peery, D.J., and Azar, J.J., Aircraft Structures, 2nd edition, McGraw – Hill, N.Y., 1999

List of Experiments:

1. Unsymmetrical Bending of a Cantilever Beam
2. Combined bending and Torsion of a Hollow Circular Tube
3. Experiment using Photo elastic setup
4. Shear Centre of a Channel Section
5. Shear center for unsymmetrical section.

AER18R373	PROPULSION – II	L	T	P	C
Pre – Requisites	AER18R275	3	0	2	4
Course Category	Program Core				
Course Type	Integrated Course				

Course Objective:

To have introduction of advanced propulsion system.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Comprehend the working of turbine, blade profiles, performance, cooling methods in turbine blades and its limitations
CO2: Interpret the operating principle of Ramjet, combustion and its performance
CO3: Explain the basics of Scramjet engine and integral Ram Engine
CO4: Demonstrate the rocket operating principles. Rocket nozzle classifications and performance of rockets
CO5: Explain about Electric, ion and nuclear rockets. The basics of Solar Sails and its operating principle

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2		2								1	2		1
CO2		2	2										1		1
CO3		1	2	1											
CO4	3											1	2	1	1
CO5	1		1										1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

TURBINES FOR JET ENGINES

Principle of operation of axial flow turbines – work done and pressure rise – degree of reaction – types of design of turbines – turbine blade cooling- velocity diagrams- limitations of radial flow turbines- compressor & turbine matching – materials for turbine blades

UNIT 2

RAMJET PROPULSION

Operating principle of ramjet engine – various components of ramjet engines and their efficiencies – Combustion in ramjet engine – critical, subcritical and supercritical modes of operation -ramjet engine and its performance characteristics – sample ramjet design calculations – flame stability problems in ramjet combustors –integral ram rockets

UNIT 3

HYPERSONIC AIRBREATHING PROPULSION

Introduction to hypersonic air breathing propulsion, hypersonic vehicles and supersonic combustion- need for supersonic combustion for hypersonic propulsion – salient features of scramjet engine and its applications for hypersonic vehicles – problems associated with supersonic combustion – engine/airframe integration aspects of hypersonic vehicles – various types scramjet combustors – fuel injection schemes in scramjet combustors – one dimensional models for supersonic combustion using method of influence coefficients.

UNIT 4

CHEMICAL ROCKET PROPULSION

Operating principle – specific impulse of a rocket – internal ballistics – rocket performance considerations – solid propellant rockets – selection criteria of solid propellants – propellant grain design considerations – erosive burning in solid rockets – liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets -thrust control in liquid rockets – cooling in liquid rockets and the associated heat transfer problems – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion - static testing of rockets and safety considerations

UNIT 5

ADVANCED PROPULSION TECHNIQUES

Introduction to nozzleless propulsion and basic concepts - Electric rocket propulsion – Ion propulsion – Nuclear rocket – comparison of performance of these propulsion systems with chemical rocket propulsion systems - Solar sail.

Text Books:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons; 8th Edition 2010.
2. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.

References:

1. David H. Heiser and David T. Pratt., "Hypersonic Air breathing Propulsion", AIAA Education Series, 1999.

List of Experiments:

1. Wall pressure measurements of a turbine blade passage
2. Burn rate measurements of solid propellants
3. Cascade testing of compressor blades
4. Prediction of potential core length in co-axial jets
5. Flow visualization of secondary injection in a supersonic cross flow

AER18R301	FLIGHT DYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Program Core				
Course Type	Theory				

Course Objective:

Make the students to solve the preliminary aircraft design calculations using the steady and accelerated flight performance.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Evaluate the performance characteristics like aerodynamic forces and power variations of aircraft
CO2: Interpret the range, endurance, climbing, gliding and various maneuvering performances of an aircraft along with load factor and its limitations.
CO3: Illustrate the degrees of freedom and static longitudinal stability attained in aircraft
CO4: Correlate the aircraft's lateral and directional stability
CO5: Estimate the response of aircraft in various oscillatory modes of aircraft stability

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3			2	1								3	1	
CO2	2	1		1	3								2	3	
CO3	2	2	1	3	1								2	1	
CO4	1	2		3	2								1	3	
CO5	2	2		1	3								1	2	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

STEADY LEVEL FLIGHT

International Standard atmosphere, IAS, EAS, TAS, Streamlined and bluff body, Types of drag, Effect of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes, Drag polar, Effect of Mach number on drag polar. Concept of sweep- effect of sweep on drag. General equation of motion of an airplane. Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Effect of drag divergence on maximum velocity, Range and Endurance of Propeller and Jet aircrafts. Effect of wind on range and endurance

UNIT 2

GLIDING AND CLIMBING FLIGHT

Shallow and steep angles of climb, Rate of climb, Maximum Climb angle and Maximum Rate of climb-, Absolute and service ceiling, Cruise climb, Gliding flight, Estimation of take-off and

landing distances, Methods of reducing landing distance, level turn, minimum turn radius, maximum turn rate, bank angle and load factor, Constraints on load factor, Pull up and pull down maneuvers, V-n diagram

UNIT 3

STATIC LONGITUDINAL STABILITY AND CONTROL

General concepts-Degrees of freedom of a rigid body, Static and dynamic stability, contribution to stability by wing, tail, fuselage, wing fuselage combination, Total longitudinal stability, Neutral point-Stick fixed and Stick free aspects, static margin, Hinge moment, , elevator control power, elevator angle to trim, elevator angle per g.

UNIT 4

STATIC DIRECTIONAL AND LATERAL STABILITY AND CONTROL

Directional stability-yaw and sideslip, Criterion of directional stability, contribution to static directional stability by wing, fuselage, tail, Lateral stability-Dihedral effect, criterion for lateral stability, evaluation of lateral stability- contribution of fuselage, wing, wing fuselage, tail, aileron effectiveness, strip theory estimation of aileron effectiveness

UNIT 5

DYNAMIC LONGITUDINAL STABILITY

Aircraft Equations of motion, small disturbance theory, Estimation of longitudinal stability derivatives stability derivatives, Routh's discriminant, solving the stability quartic, Phugoid motion, Factors affecting the period and damping. Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directional dynamics.

Text Books:

1. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Arnold Publishers, 1988.
2. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 1999

References:

1. Kuethe, A.M. and Chow, C.Y., Foundations of Aerodynamics, John Wiley & Sons; 5th Edition, 1997.
2. John J Bertin., Aerodynamics for Engineers, Prentice Hall; 6th edition, 2013.
3. Clancy, L J., Aerodynamics, Shroff publishers (2006)
4. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015

AER18R481	AERO DESIGN PROJECT	L	T	P	C
Pre – Requisites	Nil	0	0	3	2
Course Category	Program Core				
Course Type	Laboratory				

Course Objective:

To develop the basic concept of aircraft design by assigning each student a preliminary specification to design an airplane or helicopter or any flight vehicle

Course Outcomes:

After completing this course, the student will be able to:

CO1: see how aircraft design changes from one mission to another
CO2: Calculate the design parameter for the aircraft is selected
CO3: Estimate weight of the aircraft components
CO4: Estimate drag and find C.G of an aircraft
CO5: Draw v-n diagram and to find a stall region

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1		3											3	
CO2			3											3	
CO3			3											3	
CO4			3											3	
CO5	2		3											3	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

List of Experiments:

1. Comparative configuration study of different types of airplanes
2. Comparative study on specification and performance details of aircraft
3. Preparation of comparative data sheets
4. Worksheet layout procedures
5. Comparative graphs preparation and selection of main parameters for the design
6. Preliminary weight estimations, selection of main parameters
7. Power plant selection, air foil selection, wing tail and control surfaces
8. Preparation of layouts of balance diagram and three view drawings
9. Drag estimation, weight calculation and v-n diagram
10. Detailed performance calculations and stability estimates

PROGRAM ELECTIVE COURSES

AER18R302	AIRCRAFT SYSTEMS AND INSTRUMENTS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To make the student to understand the principle and working of aircraft systems and instruments.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain schematic diagram of a hydraulic system for a modern aircraft and explain its function
CO2: Comprehend the working principle of modern control system & its advantages
CO3: Describe the various systems of piston & gas turbine engines and the purpose of each system
CO4: Describe the working principle of air conditioning system & fire protection system
CO5: Understand the working principle of aircraft instruments and engine instruments in detail

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2			2									3		
CO2	2			2									1		
CO3	2			2			2						1		
CO4	2			1									1		
CO5	3			3									1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

AIRCRAFT SYSTEMS

Hydraulic systems – Study of typical systems – components – Hydraulic systems controllers – Modes of operation – Pneumatic systems – Working principles – Typical Pneumatic Power system – Brake system – Components, Landing Gear Systems – Classification – Shock absorbers – Retractive mechanism.

UNIT 2

AIRPLANE CONTROL SYSTEMS

Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Engine control systems – Push pull rod system – operating principles – Modern control systems – Digital fly by wire systems – Auto pilot system, Active Control Technology.

UNIT 3

ENGINE SYSTEMS

Piston and Jet Engines- Fuel systems – Components - Multi-engine fuel systems, lubricating systems – Starting and Ignition systems

UNIT 4

AIRCONDITIONING AND PRESSURIZING SYSTEM

Basic Air Cycle systems – Vapour Cycle Systems, Boot-strap air cycle system – Evaporative vapour cycle systems – Evaporation air cycle systems – Oxygen systems – Fire extinguishing system and smoke detection system, Deicing and anti-icing system.

UNIT 5

AIRCRAFT INSTRUMENTS

Flight Instruments and Navigation Instruments – Accelerometers, Air speed Indicators – Mach Meters – Altimeters - Gyroscopic Instruments– Principles and operation – Study of various types of engine instruments – Tachometers – Temperature and Pressure gauges.

Text Books:

1. Mekinley, J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill 1993.
2. Pallet, E.H.J. Aircraft Instruments & Principles, Pitman & Co 1993.

References:

1. Teager, S, “Aircraft Gas Turbine technology, McGraw Hill 1997.
2. McKinley, J.L. and Bent R.D. Aircraft Maintenance & Repair, McGraw Hill, 1993.
3. Handbooks of Airframe and Power plant Mechanics, US dept. of Transportation, Federal, Aviation Administration, the English Book Store, New Delhi, 1995

AER18R303	AEROSPACE MATERIALS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Enhance the students to select the material for an aircraft components.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Distinguish the requirements of aerospace materials and atomic structure of materials
CO2: Classify the material based on its mechanical behavior.
CO3: Acquire knowledge about the properties of material, the process of machining them and heat treating them.
CO4: Acquire knowledge about the specification of materials, their structural applications and properties.
CO5: Illustrate the high temperature material characterization.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		2									2		
CO2	3	2		2									2		
CO3	3	2											2		
CO4	3	2											2		
CO5	3	1											2		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

ELEMENTS OF AEROSPACE MATERIALS

Structure of solid materials – Atomic structure of materials – Crystal structure – Miller indices – Density – Packing factor – Space lattices – X-ray diffraction – Imperfection in crystals – general requirements of materials for aerospace applications.

UNIT 2

MECHANICAL BEHAVIOUR OF MATERIALS

Linear and non linear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect – Notch effect testing and flaw detection of materials and components – Comparative study of metals, ceramics plastics and composites.

UNIT 3

CORROSION & HEAT TREATMENT OF METALS AND ALLOYS

Types of corrosion – Effect of corrosion on mechanical properties – Stress corrosion cracking – Corrosion resistance materials used for space vehicles Heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – Effect of alloying treatment, heat resistance alloys – tool and die steels, magnetic alloys, powder metallurgy.

UNIT 4

CERAMICS AND COMPOSITES

Introduction – physical metallurgy – modern ceramic materials – cermets - cutting tools – glass ceramic –production of semi fabricated forms - Plastics and rubber Carbon/Carbon composites, Fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design

UNIT 5

HIGH TEMPERATURE MATERIALS CHARACTERIZATION

Classification, production and characteristics – Methods and testing – Determination of mechanical and thermal properties of materials at elevated temperatures – Application of these materials in Thermal protection systems of Aerospace vehicles – super alloys – High temperature material characterization.

References:

1.Titterton.G., Aircraft Materials and Processes, V Edition, Pitman Publishing Co., 1995.

2.Martin, J.W., Engineering Materials, Their properties and Applications, Wykedham Publications (London) Ltd., 1987.

3.Van Vlack.L.H., Elements of Materials Science and Engineering Prentice Hall; publishers, 6th edition, 1989

4.Raghavan.V., Materials Science and Engineering, Prentice Hall of India, New Delhi,5th edition, 2004.

AER18R304	AIRCRAFT DESIGN	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Enable the students to design the aircraft.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Infer the design parameters affecting the aircraft configuration and check the feasibility of Manufacturing.

CO2: Estimate the weight of the individual components of aircraft

CO3: Select and locate the aircraft engines in the configuration.

CO4: Determine the wing, fuselage and tail sizing parameters

CO5: Interpret the loads acting on aircraft and estimate the landing gear sizing parameters.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2												2		
CO2		3	2	2										1	
CO3	2												2		
CO4	2												2		
CO5		2	2	3									2		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION

State of art in airplane design, Purpose and scope of airplane design, Classification of airplanes based on purpose and configuration. Factors affecting configuration, Merits of different plane layouts. Stages in Airplane design. Designing for manufacturability, Maintenance, Operational costs, Interactive designs.

UNIT 2

PRELIMINARY DESIGN PROCEDURE

Data collection and 3-view drawings,· their purpose, weight estimation, Weight equation method – Development & procedures for evaluation of component weights. Weight fractions for various segments of mission. Choice of wind loading and thrust Loading.

UNIT 3

OWER PLANT SELECTION

Choices available, comparative merits, Location of power plants, Functions dictating the locations.

UNIT 4

DESIGN OF WING, FUSELAGE AND EMPHANAGE

Selection of aerofoil. Selection of Wing parameters, selection of sweep, Effect of Aspect ratio, Wing Design and Airworthiness requirements, V-n diagram, loads, Structural features. Elements of fuselage design, Loads on fuselage, Fuselage Design. Fuselage and tail sizing. Determination of tail surface areas, Tail design, Structural features, Check for nose wheel lift off.

UNIT 5

DESIGN OF LANDING GEAR AND CONTROL SURFACE

Landing Gear Design, Loads on landing gear, Preliminary landing gear design. Elements of Computer Aided and Design, Special consideration in configuration lay-out, Performance estimation. Stability aspects on the design of control surface.

Text Books:

1. Torenbeck, E. Synthesis of Subsonic Airplane Design, Delft University Press, U.K. 1986
2. Raymer, D.P. Aircraft conceptual Design, AIAA series, 5th edition, 2012.

References:

Kuechemann, D, "The Aerodynamic Design of Aircraft, American Institute of Aeronautics publishers, 2012

AER18R305	AIRCRAFT ENGINE REPAIRS AND MAINTENANCE	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To make the students to understand the maintenance and repair procedures of both piston and gas turbine engines and their procedures followed for overhaul of aero engines.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Describe the function of each component in piston engines and its materials. Carryout inspections and maintenance checks on aircraft piston engines; Piston engine overhaul procedure.
CO2: Investigate the performance of propeller and to detect the damages in the propeller.
CO3: Inspect damage in engine components using NDT.
CO4: Know the overhaul procedures and functions of each component in gas turbine engines; describe the trouble shooting and rectification procedures of gas turbine engines
CO5: Know the overhaul procedures and balancing of gas turbine components

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3			2								2	2		
CO2	2	1		1									1		
CO3	1	1		2										1	2
CO4	3			2								2	2		
CO5	2			1								1	1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Classification of piston engines - Principles of operation - Function of components - Materials used- Details of starting the engines - carburetion and Fuel injection systems for small and large engines - Ignition system components - spark plug detail - Engine operating conditions at various altitudes – Engine power measurements – Classification of engine lubricants and fuels – Induction, Exhaust and cooling system - Maintenance and inspection check to be carried out. Inspection and maintenance and troubleshooting - Inspection of all engine components - Daily and routine checks- Overhaul procedures - Compression testing of cylinders - Special inspection schedules - Engine fuel, control and exhaust systems - Engine mount and super charger - Checks and inspection procedures.

UNIT 2

Propeller theory - operation, construction assembly and installation -Pitch change mechanism- Propeller axially system- Damage and repair criteria - General Inspection procedures - Checks on

constant speed propellers - Pitch setting, Propeller Balancing, Blade cuffs, Governor/Propeller operating conditions – Damage and repair criteria.

UNIT 3

Symptoms of failure - Fault diagnostics - Case studies of different engine systems - Rectification during testing equipments for overhaul: Tools and equipments requirements for various checks and alignment during overhauling - Tools for inspection - Tools for safety and for visual inspection - Methods and instruments for non-destructive testing techniques - Equipment for replacement of parts and their repair. Engine testing: Engine testing procedures and schedule preparation - Online maintenance.

UNIT 4

Types of jet engines – Fundamental principles – Bearings and seals - Inlets - compressors-turbines-exhaust section – classification and types of lubrication and fuels- Materials used - Details of control, starting around running and operating procedures – Inspection and Maintenance-permissible limits of damage and repair criteria of engine components- internal inspection of engines- compressor washing- field balancing of compressor fans- Component maintenance procedures - Systems maintenance procedures - use of instruments for online maintenance - Special inspection procedures-Foreign Object Damage - Blade damage .

UNIT 5

Engine Overhaul - Overhaul procedures - Inspections and cleaning of components - Repairs schedules for overhaul - Balancing of Gas turbine components. Trouble Shooting: Procedures for trouble shooting - Condition monitoring of the engine on ground and at altitude - engine health monitoring and corrective methods.

References:

1. Kroes& Wild, "Aircraft Power plants ", 7th Edition - McGraw Hill, New York, 1994.
2. Turbomeca, "Gas Turbine Engines ", the English Book Store ", New Delhi, 1993. 3. United Technologies' Pratt & Whitney, " The Aircraft Gas turbine Engine and its Operation", The English Book Store, New Delhi.

AER18R306	AIRCRAFT RULES AND REGULATIONS - CAR I AND II	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To make the students to understand the Indian aviation rules 1937, relating to aviation and civil aviation requirement in India (DGCA)

Course Outcomes:

After completing this course, the student will be able to:

CO1: Know the procedure for keeping the aircraft in airworthiness conditions and describe the use of MEL, and the procedure for releasing the Aircraft under MEL.
CO2: Describe the different types of maintenance program.
CO3: Comprehend the requirements for getting AO in different categories
CO4: Describe the overhaul and inspection procedure of various instruments
CO5: Describe the detail procedure of flight test

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1								3		2	1		1		
CO2								3		2	1		1		
CO3								3		2	1		1		
CO4								3		2	1		1		
CO5								3		2	1		1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

C.A.R SERIES 'A' - PROCEDURE FOR CIVIL AIR WORTHINESS EQUIREMENTS AND RESPONSIBILITY OPERATORSVIS-A-VIS AIRWORTHINESS DIRECTORATE

Responsibilities of operators / owners; Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; Airworthiness regulations and safety oversight of engineering activities of operators. C.A.R. SERIES 'B' - ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL - Deficiency list(MEL & CDL); Preparation and use of cockpit check list and emergency list.

UNIT 2

C.A.R. SERIES 'C' - DEFECT RECORDING, MONITORING,INVESTIGATION AND REPORTING

Defect recording, reporting, investigation, rectification and analysis; Flight report; Reporting and rectification of defects observed on aircraft; Analytical study of in-fight readings & recordings; Maintenance control by reliability Method.C.A.R. SERIES 'D' - AND AIRCRAFT

MAINTENANCE PROGRAMMES Reliability Programme (Engines); Aircraft maintenance programme& their approval; On condition maintenance of reciprocating engines; TBO - Revision programme - Maintenance of fuel and oil uplift and consumption records - Light aircraft engines; Fixing routine maintenance periods and component TBOs - Initial & revisions.

UNIT 3

C.A.R. SERIES 'E' - APPROVAL OF ORGANISATIONS

Approval of organizations in categories A, B, C, D, E, F, & G; Requirements of infrastructure at stations other than parent base.C.A.R. SERIES 'F' - air worthiness and continued air worthiness: Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.

UNIT 4

C.A.R. SERIES 'L' - AIRCRAFT MAINTENANCE ENGINEER - LICENSING

Issue of AME License, its classification and experience requirements, Complete Series 'L'.C.A.R. SERIES 'M' MANDATORY MODIFICATIONS AND INSPECTIONS: Mandatory Modifications /Inspections.

UNIT 5

C.A.R. SERIES 'T' - FLIGHT TESTING OF AIRCRAFT

Flight testing of (Series) aircraft for issue of C of A; Fight testing of aircraft for which C or A had been previously issued. C.A.R. SERIES 'X' - MISCELLANEOUS REQUIREMENTS: Registration Markings of aircraft; Weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; Use furnishing materials in an aircraft; Concessions; Aircraft log books; Document to be carried on board on Indian registered aircraft; Procedure for issue of taxy permit; Procedure for issue of type approval of aircraft components and equipment including instruments.

References:

1. "Aircraft Manual (India) ", Volume - Latest Edition, The English Book Store, 171,Connaught Circus, New Delhi.
2. "Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness) ", Published by DGCA, The English Book Store, 17-1, Connaught Circus, New Delhi.
3. "Aeronautical Information Circulars (relating to Airworthiness) ", from DGCA. AdvisoryCirculars ", form DGCA.

AER18R307	APPROXIMATE METHODS IN STRUCTURAL MECHANICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Enable the students to analyze the statically indeterminate structures by approximate methods.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Define the analytical and numerical methods used in the structural mechanics
CO2: Solve the structural mechanics problems using approximate methods
CO3: Analyze the statically determinate and indeterminate structures using approximate methods.
CO4: Analyze the statically determinate and indeterminate structures using finite difference methods.
CO5: Create code generation for structural mechanics problems using approximate methods

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2											1		
CO2			2	2										1	
CO3	1	2												2	
CO4		1			2									1	
CO5		1		2	3									2	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

ANALYTICAL AND NUMERICAL METHODS

Review of analytical methods for solving ordinary differential equations related to structural mechanics problems, boundary conditions, initial conditions, Need for approximate methods, different forms of approximate solution, Numerical integration, Elementary study on calculus of variation.

UNIT 2

APPROXIMATE METHODS

Weighted residual methods: Least square method, collocation method, sub-domain method, method of moments, basic Galerkin form and modified Galerkin form, Variational method: Rayleigh Ritz method.

UNIT 3

STATIC, DYNAMIC AND STABILITY ANALYSIS

Application to statically determinate and indeterminate structures: bar, beam, torsional member. Free vibration and stability analysis, Improvement of solution accuracy.

UNIT 4

FINITE DIFFERENCE METHOD

Application to statically determinate and indeterminate structures: bar, beam, torsional member. Free vibration and stability analysis.

UNIT 5

CODE DEVELOPMENT

Numerical integration; Solution of simultaneous algebraic equations; Code generation for structural mechanics problems using approximate methods.

Text Books:

1. Szilard, R., Theory and Analysis of Plates – Classical and Numerical Methods, Prentice Hall, 1984
2. Chajes, A., Principles of Structural Stability Theory, Prentice Hall. Inc., 1987.
3. Asghar Bhatti, M., Fundamental Finite Element Analysis andApplications: with Mathematica and MATLAB Computations, John Wiley & Sons Inc, 2005
4. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey, 2003.

References:

1. Tauchert, T.R., Energy Principles in Structural Mechanics, McGraw Hill, International Student Edition, 1989.
2. Bathe, K.J., and Wilson, E. L., Numerical Methods in Finite Element Method, Prentice Hall (India) Ltd., 1985.
3. Chandrupatla R. Tirupathi, Belegundu D Ashok., Introduction to Finite Elements in Engineering, Prentice Hall (India) Ltd, 2007.
4. Reddy, J. N., An Introduction to the Finite Element Method, McGraw-Hill, 2004.

AER18R308	FINITE ELEMENT METHODS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

- To provide in depth knowledge in approximate methods in Structural mechanics problems.
- To offer understanding of One Dimensional Finite Element Analysis with various types of Elements.
- To get exposed to plane problems in Engineering Analysis including Two Dimensional Finite Element Analysis.
- To analyze any Engineering Component using FEA.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Recognize the basic fundamental equations of elasticity and solving linear system of equation.
CO2: Make familiar of basic approximate methods in Structural applications.
CO3: Recognize the basic principle of Finite Element Analysis in 1D structural and thermal application.
CO4: Ability to solve structural and non-structural problem using 2D FEM.
CO5: Equip them to effectively employ finite element method in order to simulate and launch a new engineering component to the market.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3											2		1
CO2	3	3	2	2									2		1
CO3	3	3			3										
CO4	2	3	3	2						2			2		1
CO5	2	3	2	2	3					2			2		1

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Elasticity

Introduction Stress at a point -Stress Tensor -Elementary view-differential equations of equilibrium; Strain -Displacement relation; Stress-Strain relationship in two dimensions and three dimension-Solving linear system of equations by Gaussian elimination method.-Numerical integration -Gaussian quadrature.

UNIT 2

Approximate Methods

Solution to complex engineering problems -Exact solution -Approximate Solution -mathematical modeling -differential forms of beams -Strain energy -principle of minimum total potential energy -Rayleigh Ritz method -general weighted residual statement -Weighted residual Techniques -Method of Collocation, Sub domain method, Method of least square, Galerkin's method, Method of Moments-Comparison of approximate solutions with exact solution.

UNIT 3

One Dimensional FEA

Introduction to FEM -engineering applications of FEA -Governing equation of FEM -Finite element modeling -Global Coordinates; Local Coordinates -nodal approximation -Element connectivity -shapes functions for various elements -Stiffness matrices and load vectors -global stiffness matrix -Boundary conditions -Computation of deflection, strains and stresses for axial (bar) element; tapered bar element; spring element; plane truss (spar) element; beam element -Thermal stress problem -Higher order elements -quadratic element (Shape function expressions only) -One dimension heat transfer analysis -Composite wall.

UNIT 4

Two Dimensional FEA

Introduction -Plane problems in elasticity -Plane Stress, Plane Strain and axi-symmetry -approximation of geometry and field variable -natural coordinates and global coordinates -Constant Strain Triangular (CST) element -Jacobian matrix -elasticity matrix -strain displacement matrix -element stiffness matrix -load vectors -global stiffness matrix -Computation of deflection, strains and stresses for CST element subjected to in plane load; surface traction -plane stress and plane strain problems -shape functions for CST -Thermal stress problem in two dimension -Higher order elements -six-noded triangular element (Shape function expressions only) -Two dimension heat transfer analysis -Axisymmetric formulation using triangular element -Cylinder under internal pressure.

UNIT 5

Isoparametric Element Formulation

Isoparametric formulation -Four node quadrilateral Element -Shape functions -Element stiffness matrix and force vector -Eight node quadrilateral Element (Shape function expressions only).

Text Books:

1. Chandrupatla T.R. and Belegundu A.D, "Introduction to Finite Elements in Engineering", Pearson Education, 4th Edition, 2012.
2. Rao S.S, "The Finite Element Method in Engineering", Pergammon Press, Elsevier, 2013

References:

1. Reddy J.N, "An Introduction to Finite Element Method", McGraw-Hill International Student Edition, 2005
2. Bhavikatti S.S, "Finite Element Analysis", New Age International Publishers, 2011.

3. Logan D.L, “A First course in the Finite Element Method”, Thomson Learning, sixth Edition, 2016.
4. Robert D Cook, David S and Malkucs Michael E Plesha, “Concepts and Applications of Finite Element Analysis”, Wiley, 4th Edition, 2003.
5. Raamachandran J, “Boundary and Finite Elements-Theory and problems”, Narosa Publishing House, 2000.
6. Seshu P, “Textbook of Finite Element Analysis”, PHI Learning Private Limited, 2015.
7. David V Hutton, “Fundamentals of Finite Element Analysis”, McGraw-Hill Int. Ed., 2005.

AER18R309	BOUNDARY LAYER THEORY	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Make the students to understand the fundamentals of viscous flow and adapt methods of boundary layer control in laminar flow.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Illustrate the fundamentals of viscous flow
CO2: Solve the viscous flow equations
CO3: Infer the laminar boundary layer
CO4: Explain the turbulent boundary layer
CO5: Adapt the methods of boundary layer control in laminar flow

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3												3		
CO2		3	2											2	
CO3	2												2		
CO4	2												2		
CO5		3	1	2										2	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FUNDAMENTAL EQUATIONS OF VISCOUS FLOW

Fundamental equations of viscous flow, Conservation of mass, Conservation of Momentum-Navier-Stokes equations, Energy equation, Mathematical character of basic equations, Dimensional parameters in viscous flow, Non-dimensionalizing the basic equations and boundary conditions, vorticity considerations, creeping flow, boundary layer flow

UNIT 2

SOLUTIONS OF VISCOUS FLOW EQUATIONS

Solutions of viscous flow equations, Couette flows, Hagen-Poisuelle flow, Flow between rotating concentric cylinders, Combined Couette-Poiseuille Flow between parallel plates, Creeping motion, Stokes solution for an immersed sphere, Development of boundary layer, Displacement thickness, momentum and energy thickness.

UNIT 3

LAMINAR BOUNDARY LAYER

Laminar boundary layer equations, Flat plate Integral analysis of Karman – Integral analysis of energy equation – Laminar boundary layer equations – boundary layer over a curved body-Flow separation- similarity solutions, Blasius solution for flat-plate flow, Falkner–Skan wedge flows, Boundary layer temperature profiles for constant plate temperature –Reynold's analogy, Integral equation of Boundary layer – Pohlhausen method – Thermal boundary layer calculations

UNIT 4

TURBULENT BOUNDARY LAYER

Turbulence-physical and mathematical description, Two-dimensional turbulent boundary layer equations — Velocity profiles – The law of the wall – The law of the wake – Turbulent flow in pipes and channels – Turbulent boundary layer on a flat plate – Boundary layers with pressure gradient, Eddy Viscosity, mixing length , Turbulence modelling

UNIT 5

BOUNDARY LAYER CONTROL

Boundary layer control in laminar flow-Methods of Boundary layer control: Motion of the solid wall- Acceleration of the boundary layer-Suction- Injection of different gas-Prevention of transition- Cooling of the wall-Boundary layer suction-Injection of a different gas.

Text Books:

1. White, F. M., Viscous Fluid Flow, McGraw-Hill Education; 3rd edition, 2005.

References:

1. Schlichting, H., Boundary Layer Theory, Springer publishers, 8th edition, 2000.
2. Reynolds, A, J., Turbulent Flows Engineering, John Wiley and Sons, 1980.

AER18R310	FATIGUE AND FRACTURE MECHANICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Facilitate students to explain the cause for crack initiation, crack propagation direction.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Become familiar with definition of fatigue and fracture mechanics
CO2: Analysis of cumulative damage
CO3: Analyze for crack initiation and crack growth.
CO4: Analyze for strength of cracked bodies
CO5: Analyze the damage tolerance structures

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		2	2											2	
CO2	1			1										1	
CO3	2			1											1
CO4	2	2	1												1
CO5			2												3

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FATIGUE OF STRUCTURES

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves – Fatigue of composite materials

UNIT 2

STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques Cumulative damage - Miner's theory - Other theories.

UNIT 3

FRACTURE MECHANICS

Bodies - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT 4

FATIGUE DESIGN AND TESTING

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

UNIT 5

FATIGUE DESIGN AND TESTING

Safe life and Fail- safe design philosophies- Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures

Text Books:

1. Prashant Kumar – Elements of fracture mechanics" Tata McGraw Hill Education Private Limited ,2009.
2. Barrois W, Ripley, E.L., "Fatigue of aircraft structure," _ Pergamon press. Oxford, 1983.

References:

1. Sih C.G., Sijthoff and W Noordhoff, "Mechanics of fracture Vol - I" International Publishing Co., Netherlands, 1989.
2. Knott, J.F., "Fundamentals of Fracture Mechanics," - Buterworth& Co., Ltd., London, 1983.
3. KareHellan ,'Introduction to Fracture Mechanics', McGraw Hill, Singapore,1985

AER18R311	FUNDAMENTALS OF CONTROL ENGINEERING	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To Understand the basic concepts of flight control system.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Relate the pneumatic, hydraulic and thermal systems with electrical system.
CO2: Deduce the block diagram of the control system and to draw the signal flow graph.
CO3: Characterize the control system inputs and their response.
CO4: Check the stability criteria of control systems using Routh-Hurwitz criteria, Root locus and Bode plot techniques.
CO5: Utilize the digital PID controllers

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2												1	
CO2			2		1										2
CO3			2	3	1								1		
CO4		2												2	
CO5	1												1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION

Historical review, Simple pneumatic, hydraulic and thermal systems, Series and parallel system, Analogies, mechanical and electrical components, Development of flight control systems.

UNIT 2

OPEN AND CLOSED LOOP SYSTEMS

Feedback control systems – Control system components - Block diagram representation of control systems, Reduction of block diagrams, Signal flow graphs, Output to input ratios.

UNIT 3

CHARACTERISTIC EQUATION AND FUNCTIONS

Response of systems to different inputs viz., Step impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.

UNIT 4

CONCEPT OF STABILITY

Necessary and sufficient conditions, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, Concept and construction, frequency response.

UNIT 5

SAMPLED DATA SYSTEMS

Z-Transforms Introduction to digital control system, Digital Controllers and Digital PID controller

Text Books:

1. OGATO, Modern Control Engineering, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
2. Azzo, J.J.D. and C.H. Houpis, Feedback control system analysis and synthesis, McGraw- Hill international 3rs Edition, 1998.

References:

1. Kuo, B.C. Automatic control systems, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998.
2. Houpis, C.H. and Lamont, G.B. Digital control Systems, McGraw Hill Book co., New York, U.S.A. 1995.
3. Naresh K Sinha, Control Systems, New Age International Publishers, New Delhi,1998.

AER18R312	MISSILE AERODYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Facilitate students to analyze the missile aerodynamic characteristics, formulate go

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain the basic characteristics of Missile aerodynamics
CO2: Summarize the missile configuration and drag estimation
CO3: Classify the aerodynamics of slender and blunt bodies
CO4: Develop the aerodynamic aspects of launching phase
CO5: Formulate the stability and control of missiles

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3												3		
CO2		1											1		
CO3	1	1	2										1		
CO4	1	2	3										2		
CO5		2	3	2									2		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

BASICS ASPECTS OF MISSILE AERODYNAMICS

Classification of missiles-Aerodynamics characteristics and requirements of air to air missiles, air to surface missiles and surface to air missiles-Missile trajectories-fundamental aspects of hypersonic aerodynamics.

UNIT 2

MISSILE CONFIGURATIONS AND DRAG ESTIMATION

Types of Rockets and missiles-various configurations-components-forces on the vehicle during atmospheric flight-nose cone design and drag estimation

UNIT 3

AERODYNAMICS OF SLENDER AND BLUNT BODIES

Aerodynamics of slender and blunt bodies, wing-body interference effects-Asymmetric flow separation and vortex shedding-unsteady flow characteristics of launch vehicles- determination of aero elastic effects

UNIT 4

AERODYNAMIC ASPECTS OF LAUNCHING PHASE

Booster separation-cross wind effects-specific considerations in missile launching-

missile integration and separation-methods of evaluation and determination- Wind tunnel tests – Comparison with CFD Analysis.

UNIT 5

STABILITY AND CONTROL OF MISSILES

Forces and moments acting on missiles-Lateral, rolling and longitudinal moments-missile dispersion-stability aspects of missile configuration-Aerodynamic control methods-Jet control methods-Stability derivatives.

References:

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1985.
2. Chin SS, Missile Configuration Design, McGraw Hill, New York, 1961.
3. John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", AIAA; 2nd edition, 2006
4. Nielsen, Jack N, Stever, Gutford, "Missile Aerodynamics", McGraw Hill, New York, 1960.
5. John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", McGraw Hill Publishing Company, 3rd edition, 2002.

AER18R313	STRUCTURAL DYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Facilitate students to analyze the vibrational effects on structure using direct and approximate methods.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain the force deflection properties of structures
CO2: Inspect the vibrations and response to vibration of the system.
CO3: Examine the natural modes of vibrations.
CO4: Dissect the choice of energy methods for vibration analysis.
CO5: Examine a range of approximate methods for vibration analysis.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1											1		
CO2	1		2												
CO3	2														
CO4			3	1									2		
CO5	2												1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FORCE DEFLECTION PROPERTIES OF STRUCTURES

Constraints and Generalized coordinates – Virtual work and generalized forces – Force – Deflection influence functions – stiffness and flexibility methods.

UNIT 2

PRINCIPLES OF DYNAMICS

Free and forced vibrations of systems with finite degrees of freedom – Response to periodic excitation – Impulse Response Function – Convolution Integral

UNIT 3

NATURAL MODES OF VIBRATION

Equations of motion for Multi degree of freedom Systems - Solution of Eigen value problems – Normal coordinates and orthogonality Conditions. Modal Analysis.

UNIT 4

ENERGY METHODS

Rayleigh's principle – Rayleigh – Ritz method – Coupled natural modes – Effect of rotary inertia and shear on lateral vibrations of beams – Natural vibrations of plates.

UNIT 5

APPROXIMATE METHODS

Approximate methods of evaluating the Eigen frequencies and Eigen vectors by reduced, subspace, Lanczos, Power, Matrix condensation and QR methods.

Text Books:

1. F.S. Tse, I.E. Morse and H.T. Hinkle, "Mechanical Vibrations: Theory and Applications" ,Prentice Hall of India Pvt. Ltd, New Delhi, 2004.
2. W.C. Hurty and M.F. Rubinstein, "Dynamics of Structures", Prentice Hall of India Pvt. Ltd., New Delhi 1987.

References:

1. R.K. Vierck, "Vibration Analysis", 2nd Edition, Thomas Y. Crowell & Co Harper &Row Publishers, New York, U.S.A. 1989.
2. S.P. Timoshenko ad D.H. Young, "Vibration Problems in Engineering", John Willey& Sons Inc., 1984.
3. V.Ramamurthi, "Mechanical Vibration Practice and Noise Control" Narosa Publishing House Pvt. Ltd, 2008.

AER18R314	THEORY OF PLATES AND SHELLS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Enable the students to formulate the governing equation for thin plates under different loading conditions

Course Outcomes:

After completing this course, the student will be able to:

CO1: Formulate the governing equation for thin plates under different loading conditions
CO2: Determine reaction forces acting on a simply supported rectangular plates using Navier's Method and Levy's Method
CO3: Determine reaction forces acting on a simply supported circular plates
CO4: Interpret the natural frequency of rectangular plates with different loading conditions
CO5: Determine natural frequency of rectangular plates using approximate methods

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		3											2		
CO2		3	2											2	
CO3		3	2											2	
CO4				2											2
CO5					3									2	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

CLASSICAL PLATE THEORY

Assumptions – Governing Equation – Boundary Conditions – Methods of Solution

UNIT 2

RECTANGULAR PLATES

Navier's Method of Solution for Simply Supported Rectangular Plates – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions and loadings.

UNIT 3

CIRCULAR PLATES

Governing equation. Boundary conditions. Bending of circular and annular plates for different support conditions and loading cases.

UNIT 4

STABILITY AND FREE VIBRATION ANALYSIS

Governing equation for buckling of plates. Buckling analysis of simply supported plates for different loadings. Governing equation for free vibration of rectangular plates. Natural frequency for rectangular plates for different boundary conditions.

UNIT 5

APPROXIMATE METHODS

Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

Text Books:

1. Timoshenko, S.P. Winowsky. S., and Kreger, Theory of Plates and Shells, McGraw Hill Book Co., 1990.
2. AnselUgural, Stresses in Plates & Shells, McGraw Hill, 1981
3. Varadhan.T.K. &Bhaskar.K., "Analysis of Plates – Theory and Problems", Narosa Publishing House, 2000

References:

1. Flugge, W. Stresses in Shells, Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, Dover Publications Inc.; 2nd Revised edition, 2009
3. Harry Kraus, 'Thin Elastic Shells', John Wiley and Sons, 1987.
4. Lloyd Hamilton, Donald, "Beams, Plates and Shells", McGraw Hill, 1976.
5. Reddy.J.N., "Theory & Analysis of Elastic Plates and Shells (Series in Systems and Control)", CRC press, 2nd Edition, 2006

AER18R315	WIND ENGINEERING	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Facilitate students to understand the properties of atmosphere, formulate the governing equations of atmospheric boundary layer.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Infer the properties of atmosphere
CO2: Formulate the governing equations of atmospheric boundary layer
CO3: Characterize the flow within a boundary layer
CO4: Estimate wind loading using various assessment methods
CO5: Interpret the structural and aerodynamic factor that influences the aerodynamic problems

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												1		
CO2					2									2	
CO3		2												2	
CO4			2										3		
CO5			2	3											2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

THE ATMOSPHERE

Atmospheric Circulation - Stability of atmospheres -definitions & implications - Effects of friction - atmospheric motion - Local winds, Building codes, Terrains different types.

UNIT 2

ATMOSPHERIC BOUNDARY LAYER

Governing Equations - Mean velocity profiles, Power law, logarithmic law wind speeds, Atmospheric Turbulence profiles - Spectral density function -. Length scale of turbulence, .Roughness parameters simulation techniques in wind tunnels.

UNIT 3

BLUFF BODY AERODYNAMICS

Governing equations Boundary layers and separations - Wake and Vortex formation two dimensional- StroUhal Numbers, Reynolds numbers-Separation and Reattachments Oscillatory Flow.patterns Vortex shedding flows -Time varying forces to Wind velocity in turbulent flow - Structures in three dimensional

UNIT 4

WIND LOADING

Introduction, Analysis and synthesis. Loading coefficients, local• & global coefficients pressure shear stress coefficients, force and moment coefficients - Assessment methods - Quasi steady method - Peak factor method - Extreme value method.

UNIT 5

AERO ELASTIC PHENOMENA

Vortex shedding and lock in phenomena in turbulent flows, across wind' galloping wakegalloping Torsional divergence, along wind galloping of circular cables, cross wind galloping of circular dibble's', Wind loads &. Turbulent effects on tall. Structure - Launch vehicles.

Text Books:

Emil Simiu& Robert H Scanlan, 'Wind effects of structures fundamentals and applications to design; John Wiley & Sons INC New York, 3rd edition, 1996.

References:

1. Tom Lawson, "Building Aerodynamics",Imperial College Press London, 1st edition, 2001.
2. Cook N J, Design Guides to wind loading of buildings structures. Part I & II, Burterworths, London, 1990 .

AER18R316	ACOUSTICS AND NOISE CONTROL	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To make students acquire knowledge in Acoustics study and Noise Control methods.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Understand the importance of noise control.
CO2: Analyze the concepts of Acoustics waves, and its frequencies
CO3: Distinguish the characteristics of Acoustic waves
CO4: Understand the Acoustic measurements
CO5: Know the concepts of Electro Mechanical analogies of Acoustics

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1			3									2		
CO2			1										1		
CO3	1													1	
CO4			1										1		
CO5	1												2		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Introduction

Sound, sources of sound, acoustic wave propagation, importance of noise control, Noise legislation in India, Noise quality norms and standards, governing equation of acoustics

UNIT 2

Plane waves and frequency analysis

Plane waves, Forward waves, Backward waves, reflection of plane waves, Frequency analysis- Introduction to harmonic analysis, periodic quantities, Phasors, Frequency in acoustics, stationary, non-stationary signal, Broadband, narrow broadband noise.

UNIT 3

Harmonic waves

Harmonic waves, 1-D harmonic acoustic waves, characteristic impedance, Travelling and standing waves, Acoustic mode shapes and reflection, Reflection and transmission, Flexural waves, evanescent waves, near field acoustic waves, cuton waves in duct.

UNIT 4

Measurements

Power calculation- acoustic intensity, decibel scale, decibel arithmetic, SPL, SWL, SIL, Frequency bands, Human factors in acoustic Engineering, Acoustic measurements, Microphone, parameters of microphone selection, Condenser microphone, Moving coil microphone, Piston phone, Sound power measurement, Sound level meter, Sound intensity measurement.

UNIT 5

Muffler analysis

Muffler analysis, transfer matrix method for expansion chamber muffler, Electro mechanical analogies, source impedance, insertion loss, analysis of industrial mufflers, spherical waves, monopole and dipole, Inhomogeneous wave equation, green's function, Kirchhoff Helmholtz integral equation

Text Books:

1. Fundamentals of Acoustics by L. E. Kinsler, A. R. Frey, A. B. Coppens and J. V. Sanders, John Wiley Sons(2000).
2. Foundations of Engineering Acoustics by F. H. Fahy, Academic Press (2001).
3. Acoustics of ducts & Mufflers by M. L. Munjal, Wiley 2014.

AER18R401	AERO ELASTICITY	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Facilitate the students to comprehend effect aero-elastic problems in an aircraft stability.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Interpret the interaction between aerodynamics and aircraft structures
CO2: Determine the divergence speed using strip theory and successive approximation.
CO3: Estimate the aileron reversal speed using semi-rigid theory
CO4: Interpret the effect of moment of inertia on flutter speed.
CO5: Comprehend the aero-elastic problems in civil, electrical lines and helicopters.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		2											2		
CO2	2												1		
CO3	1													2	
CO4			3											1	
CO5		3												1	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

AERO ELASTICITY PHENOMENA

Vibration of beams due to coupling between bending and torsion - The aero-elastic triangle of forces - Stability versus response problems – Aeroelasticity in Aircraft Design – Vortex induced vibration – Introduction to aero servo elasticity.

UNIT 2

DIVERGENCE OF A LIFTING SURFACE

Simple two dimensional idealizations – Strip theory – Fredholm integral equation of the second kind – Exact solutions for simple rectangular wings – Semi rigid assumption and approximate solutions – Generalized coordinates – Successive approximations – Numerical approximations using matrix equations.

UNIT 3

STEADY STATE AEROELASTIC PROBLEMS

Loss and reversal of aileron control – Critical aileron reversal speed – Aileron efficiency – Semi rigid theory and successive approximations – Lift distributions – Rigid and elastic wings.

UNIT 4

FLUTTER ANALYSIS

Non-dimensional parameters – Stiffness criteria Dynamic mass balancing – Model experiments – Dimensional similarity – Flutter analysis – Two dimensional thin airfoils in steady incompressible flow – Quasi steady aerodynamic derivatives – Galerkin's method for critical speed – Stability of distributed motion – Torsion flexure flutter – Solution of the flutter determinant – Methods of determining the critical flutter speeds – Flutter prevention and control.

UNIT 5

EXAMPLES OF AEROELASTIC PROBLEMS

Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges – Aircraft wing flutter- Vibrational problems in Helicopters.

Text Books:

1. Fung, Y.C. An Introduction to the theory of Aeroelasticity, Dover Publications Inc., 2008

References:

1. Bisplinghoff., R.L. Ashley, H., and Halfman, R.L, " Aeroelasticity" Addison Wesley Publishing Co., Inc. II ed. 1996.
2. Broadbent, E.G., Elementary Theory of Aeroelasticity, Bunhill Publications Ltd., 1986.
3. Scanlan, R.H. and Rosenbaum, R., Introduction to the Study of Aircraft Vibration and Flutter, Macmillan Co., N.Y., 1991.
4. Blevins R.D, "Flow induced vibrations", Krieger Pub Co; 2 Reprint edition, 2001.

AER18R402	UAV SYSTEM DESIGN	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Enable the students to design the UAV systems.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Outline the fundamentals of UAV
CO2: Illustrate the designs of UAV systems.
CO3: Select the avionics hardware systems for the configuration
CO4: Estimate the payloads and operation range
CO5: Test the UAV and develop ground control software

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												3		
CO2	2												3		
CO3	3												2		
CO4										3					
CO5			3										1		2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION TO UAV

History of UAV –classification – Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications

UNIT 2

THE DESIGN OF UAV SYSTEMS

Introduction to Design and Selection of the System- Aerodynamics and AirframeConfigurations- Characteristics of Aircraft Types- Design Standards and Regulatory Aspects-UK,USA and Europe- Design for Stealth--control surfaces-specifications.

UNIT 3

AVIONICS HARDWARE

Autopilot –AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration, and testing

UNIT 4

COMMUNICATION PAYLOADS AND CONTROLS

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range –modems-memory system-simulation-ground test-analysis-trouble shooting

UNIT 5

DEVELOPMENT OF UAV SYSTEMS

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing-Future Prospects and Challenges-Case Studies – Mini and Micro UAVs.

References:

1. Reg Austin "unmanned aircraft systems UAV design, development and deployment", Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
3. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
4. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998

AER18R403	HEAT TRANSFER	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

The course is intended to build up necessary background for understanding the physical behavior of various modes of heat transfer like conduction, convection, and radiation.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain the difference between various modes of heat transfer and the resistance concepts used in heat conduction
CO2: Learn to use the basic methods in conduction. Understand the concept of lump parameter analysis and when it is applicable and earn the concepts of boundary layer
CO3: Learn to apply various correlation used in convective heat transfer and understand the concepts of black body, grey body, view factor, Radiation shielding
CO4: Solve 1-D and 2-D steady, and unsteady state heat conduction using numerical methods
CO5: Learn to apply various technique used for high speed flow heat transfer.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3												2		
CO2		3	2	2									1		
CO3		3	2	2									1		
CO4	3	2	1	2									1		
CO5				3									1		2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

CONDUCTION

Governing equation in Cartesian, cylindrical and spherical coordinates. 1-D steady state heat conduction with and without heat generation. Composite wall- Electrical analogy – Critical thickness of insulation – Heat transfer from extended surface – Effect of temperature on conductivity- 1-D Transient analysis

UNIT 2

CONVECTION

Review of basic equations of fluid flow – Dimensional analysis- Forced convection – Laminar flow over flat plate and flow through pipes-Flow across tube banks. Turbulent flow over flat plate and flow through pipes – Free convection – Heat transfer from vertical plate using integral method – Empirical relations - Types of heat exchangers – Overall heat transfer coefficient – LMTD and NTU methods of analysis

UNIT 3

RADIATION

Basic definitions – Concept of black body - Laws of black body radiation-Radiation between black surfaces – Radiation heat exchange between grey surfaces – Radiation shielding – Shape factor-Electrical network analogy in thermal radiation systems

UNIT 4

NUMERICAL METHODS

1-D and 2-D steady and unsteady state heat conduction – composite walls-heat generation-variable thermal conductivity- extended surfaces analysis using finite difference method-Convective heat transfer- Stream function- vorticity method- Creeping flow analysis-convection-diffusion 1-D, 2-D analysis using finite difference approximation. Numerical methods applicable to radiation heat transfer.

UNIT 5

CASE STUDIES IN AEROSPACE ENGINEERING

Numerical treatment of heat transfer problems pertaining to Aerospace Engineering like in gas turbines, rocket thrust chambers, Aerodynamic heating and Ablative heat transfer in thermal protection systems.

Text Books:

1. Yunus,A.Cengel, Heat Transfer -A Practical Approach, Tata McGraw Hill, Second edition, 2003
2. Holman,J.P., Heat Transfer, McGraw Hill Book Co.,Inc., New York, 8thEdition,1996.
3. Sachdeva,S.C., Fundamentals of Engineering Heat and Mass Transfer, new age publishers,2010.
4. NecatiOzisik, Finite Difference Method in Heat Transfer, CRC Press, second edition, 1994

References:

1. John H. Lienhard IV & John H. Lienhard V, “A Heat Transfer Text Book, Prentice Hall Inc.,1981.
2. Sutton,G.P., Rocket Propulsion Elements, John Wiley & Sons; 8th Edition 2010.
3. Mathur,M.L. and Sharma,R.P,“Gas Turbine, Jet and Rocket Propulsion”,Standard Publishers & Distributors, Delhi, 2nd edition 2014.

AER18R404	LAUNCH VEHICLES AND MISSILES	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To introduce the basic concepts of design and trajectory estimation of rocket and missiles, to study the performance of rocket and missiles under various operating conditions, and the fundamentals of design concepts

Course Outcomes:

After completing this course, the student will be able to:

CO1: Outline diverse varieties of Rockets and demonstrates the aerodynamics of launch vehicles
CO2: Examine the aerodynamics of launch vehicles
CO3: Inspect the 1-D and 2-D rocket motions in free space and homogeneous gravitational fields
CO4: Construct the staging and stage separation dynamics of rockets and launch vehicles
CO5: Inspect a range of control methods of rockets and launch vehicles.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3					1							1		
CO2	1		2										1		
CO3	2												1		
CO4	1	2											1		
CO5	1												1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

CLASSIFICATION OF ROCKETS AND LAUNCH VEHICLES

Various methods of classification of missiles and rockets-Basic Aerodynamics characteristics of launch vehicle configurations-Examples of various Indian space launch vehicles-Current status of Indian rocket programme with respect to international scenario.

UNIT 2

AERODYNAMICS OF ROCKETS AND LAUNCH VEHICLES

Airframe components of rockets and Launch Vehicles – forces acting on a missile while passing through atmosphere – slender body aerodynamics - method of describing forces and moments – lift force and lateral moment –lateral aerodynamic damping moment – longitudinal moment – drag estimation-Rocket Dispersion

UNIT 3

ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD

One dimensional and two-dimensional rocket motions in free space and homogeneous gravitational fields – description of vertical, inclined and gravity turn trajectories – determination of range and altitude – simple approximations to burn out velocity and altitude – estimation of culmination time and altitude.

UNIT 4

STAGING OF ROCKETS AND LAUNCH VEHICLES

Design philosophy behind multistaging of launch vehicles– multistage vehicle optimization– stage separation techniques in atmosphere and in space – stage separation dynamics and lateral separation characteristics.

UNIT 5

CONTROL OF ROCKETS AND LAUNCH VEHICLES

Introduction to aerodynamic control and jet control methods- thrust control methods – various types of thrust vector control methods including secondary injection thrust vector control for launch vehicles.

Text Books:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman &Co.,Ltd, London, 1982
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons; 8th Edition 2010.

References:

1. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.

AER18R405	AIRFRAME REPAIR AND MAINTENANCE	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

Airframe maintenance & repair deals with the maintenance and safety precautions and procedures of airframe systems and their troubleshooting practices.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain the welding, brazing process with the requirements of the process and significance of NDT

CO2: Interpret the various maintenance practices in plastic and composite parts of aircraft

CO3: Comprehend the precautionary steps involved in rigging, Jacking process

CO4: Gain through Understanding in parts, working methodology of basic aircraft systems.

CO5: Get a clear idea about safety practices and troubleshooting on an aircraft.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2										1		1		2
CO2	2			2											1
CO3											1	1	1		
CO4	1											1			1
CO5						2	1						1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

WELDING IN AIRCRAFT STRUCTURAL COMPONENTS

Equipments used in welding shop and their maintenance - Ensuring quality welds - Welding jigs and fixtures - Soldering and brazing. Sheet metal repair and maintenance: Selection of materials; Repair schemes; Fabrication of replacement patches; Tools - power/hand; Repair techniques; Close tolerance fasteners; Sealing compounds; forming/shaping; Calculation of weight of completed repair; Effect of weight - change on surrounding structure. Sheet metal inspection - N.D.T. Testing. Riveted repair design - Damage investigation - Reverse engineering

UNIT 2

PLASTICS AND COMPOSITES IN AIRCRAFT

PLASTICS IN AIRCRAFT: Review of types of plastics used in airplanes - Maintenance and repair of plastic components - Repair of cracks, holes etc., and various repairs schemes - Scopes. ADVANCED COMPOSITES IN AIRCRAFT: Cleaning of fibre reinforced plastic (FRP) materials prior to repair; Break test - Repair Schemes; FRP/honeycomb sandwich materials; laminated FRP structural members and skin panels; Tools/equipment; Vacuum-bag process. Special precautions – Autoclaves

UNIT 3

AIRCRAFT JACKING, ASSEMBLY AND RIGGING

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces - Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

UNIT 4

REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM

Trouble shooting and maintenance practices - Service and inspection - Inspection and maintenance of landing gear systems. - Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments - handling - Testing - Inspection. Inspection and maintenance of auxiliary systems - Fire protection systems - Ice protection system - Rain removal system -Position and warning system - Auxiliary Power Units (APUs).

UNIT 5

SAFETY PRACTICES

Hazardous materials storage and handling, Aircraft furnishing practices - Equipments. Trouble shooting.Theory and practices

Text Books:

1. Kroes, Watkins, Delp, "Aircraft Maintenance and Repair ", McGraw Hill, New York, 1992

References:

1. Larry Reithmeir, “Aircraft Repair Manual ", Palamar Books, Marquette, 1992.
2. Brimm D.J. Bogges H.E., "Aircraft Maintenance ", Pitman Publishing corp., NewYork, 1940.
3. Delp. Bent and Mckinely “Aircraft Maintenance Repair”, McGraw Hill, New York,1987.

AER18R406	AVIONICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

To introduce the basic concepts of navigation and communication systems of aircraft

Course Outcomes:

After completing this course, the student will be able to:

CO1: Design and fabricate of modern aircraft component cockpit.
CO2: Identify various cockpits in real time
CO3: Identify real time applications of microprocessor in aircraft
CO4: Apply basic concepts to aircraft instruments for efficient output
CO5: Aware of communication and navigation systems and their applications

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3		2												2
CO2	3														2
CO3	2		2												2
CO4	2		2												2
CO5	2														2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION TO AVIONICS

Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to Digital Computer and memories

UNIT 2

DIGITAL AVIONICS ARCHITECTURE

Avionics system architecture – Data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT 3

FLIGHT DECKS AND COCKPITS

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT 4

INTRODUCTION TO NAVIGATION SYSTEMS

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT 5

AIR DATA SYSTEMS AND AUTO PILOT

Air data quantities – Altitude, Air speed, Vertical speed, Mach number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

Text Books:

1. Albert Helfrick.D., Principles of Avionics, Avionics Communications Inc., 2004
2. Collinson.R.P.G. Introduction to Avionics, Chapman and Hall, 1996.

References:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical,Longman Group UK Ltd., England, 1989.
3. Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.
4. Spitzer. C.R. The Avionics Hand Book, CRC Press, 2000

AER18R407	COMBUSTION IN AEROSPACE VEHICLES	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

To make the students to examine the characteristics of flame and factors influencing the combustion efficiency.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Examine the characteristics of flames
CO2: Interpret the factors affecting the combustion efficiency and to prevent the detonation.
CO3: Estimate the combustor sizing parameters and its combustion efficiency
CO4: Examine the influences of shock waves in supersonic combustion
CO5: Categorize the performance characteristics of different chemical rockets

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3		2												2
CO2	3														2
CO3	2		2												2
CO4	2		2												2
CO5	2														2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FUNDAMENTAL CONCEPTS IN COMBUSTION, CHEMICAL KINETICS AND FLAMES

Thermochemical equations – heat of reaction- first, second and third order reactions – premixed flames – diffusion flames – laminar and turbulent flames - measurement of burning velocity – various methods – effect of various parameters on burning velocity – flame stability – deflagration – detonation – Rankine-Hugoniot curves – radiation by flames

UNIT 2

COMBUSTION IN AIRCRAFT PISTON ENGINES

Introduction to combustion in aircraft piston engines – various factors affecting the combustion efficiency - fuels used for combustion in aircraft piston engines and their selection – detonation in piston engine combustion and the methods to prevent the detonation

UNIT 3

COMBUSTION IN GAS TURBINE AND RAMJET ENGINES

Combustion in gas turbine combustion chambers - recirculation – combustion efficiency, factors affecting combustion efficiency, estimation of adiabatic flame temperature in gas turbine combustion chambers – combustion stability –differences between the design of combustion chambers of ramjet and gas turbine engines - various types of flame holders for combustion chambers – salient features of after-burners

UNIT 4

SUPERSONIC COMBUSTION

Introduction to supersonic combustion – supersonic combustion controlled by diffusion, mixing and heat convection – analysis of reactions and mixing processes - supersonic burning with detonation shocks - various types of supersonic combustors – high intensity combustors.

UNIT 5

COMBUSTION IN SOLID, LIQUID AND HYBRID ROCKETS

Solid propellant combustion - double and composite propellant combustion – various combustion models – combustion in liquid rocket engines – single fuel droplet combustion model – combustion models for hybrid rockets

Text Books:

1. Sharma, S.P., and Chandra Mohan, “Fuels and Combustion”, Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987.
2. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 2nd edition 2014.

References:

1. Loh, W.H.T., “Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design(Applied Physics and Engineering)”, Springer Verlag, New York, 2012.
2. Beer, J.M., and Chegar, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.
3. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons; 8th Edition 2010.

AER18R408	DESIGN OF GAS TURBINE ENGINE COMPONENTS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

Enable the students to design the aircraft engine components.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Estimate the preliminary design parameters of aircraft engine components
CO2: Characterize the flow properties and examine the engine performance
CO3: Investigate the rotary components and its aerodynamic performance
CO4: Design the subsonic combustion chamber
CO5: Differentiate nozzle and diffuser functions, its geometry.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		3	1										3	
CO2			3											3	
CO3			3	1										3	
CO4			3	1										3	
CO5			3	1										3	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

GAS TURBINE ENGINE DESIGN FUNDAMENTALS

Design Process- compressible flow relationship; Constrain Analysis- Concept-Design tools-preliminary estimates; Mission analysis-Concept- design tools-Aircraft weight and fuel consumption data-Example problems on Constrain analysis, Mission analysis

UNIT 2

ON DESIGN AND OFF-DESING PARAMETRIC ANALYSIS

Total and static properties-corrected mass flow rate-Engine Cycle Design- One-Dimensional Through flow Area-Flow path force on components- aircraft constraint analysis, aircraft mission analysis, engine parametric (design point) analysis, engine performance (offdesign) analysis, engine installation drag and sizing.

UNIT 3

DESIGN OF ROTATING COMPONENTS

Engine Component Design-Fan and Compressor Aerodynamics-Diffusion factorAerofoil geometry-Flow path dimension-Radial variation-Turbine Aerodynamics- Constant axial velocity-adiabatic-selected Mach number-Mean line stage Design-stage pressure ratio-Airfoil geometry-

radial variation-turbine cooling-range of turbine parameter-Engine lifeDesign Example –fan-compressor-turbine.

UNIT 4

COMBUSTION CHAMBER DESIGN

Engine Component Design: Combustion system components- Combustion- Chemical reactor theory. Combustor Stability map-Stirring and mixing-Total pressure loss-FuelsIgnition-Combustion Systems of Main Burner Design: Air partitioning- Main burner component Design: Diffuser-types of burner-inner and outer casing Design-Fuel- nozzle-
Dome and liner-Primary zone- swirler- Secondary holes-Dilution holes-Transition duct-Example Design calculation: Design of Afterburners-Design parameters-ComponentsDiffuser-Fuel injection-Ignition-Flame stabilization- Flame spread and after burner lengthExamples design calculation.

UNIT 5

INLET AND NOZZLE DESIGN

Inlets and Exhaust Nozzles Design: Elements of a Successful Inlet-Engine IntegrationProgram-Definition of Subsonic Inlet-Engine Operational Requirements- Definition ofSupersonic Inlet-Engine Operational Requirements- Engine Impact on Inlet Design- Inlet Impact on Engine Design-Validation of Inlet-Engine System-Exhaust nozzle design-Nozzle types and their design -Jet control methods for reduction of infrared signature-Simple design problem on dimensional nozzle flow

Text Books:

1. Aircraft Engine Design,Second Edition,by J.D. Mattingly, W.H. Heiser, and D.T. Pratt, 2002, AIAA Education Series, AIAA
2. Aircraft Propulsion Systems Technology and Design, by G.C. Oates (ed.), 1989, AIAA Education Series, AIAA
3. H.I.H. Saravanamuttoo , G.F.C. Rogers, “Gas Turbine Technology”, Pearson Education Canada; 6th edition, 2008.

References:

1. High-Speed Flight Propulsion Systems, by S.N. Murthy and E.T. Curran(eds.), 1991, Volume 137, Progress in Astronautics and Aeronautics, AIAA
2.N.Cumpsty, JetPropulsion: A Simple Guide to the Aerodynamics and thermodynamics Design and Performance of Jet Engines” , Cambridge University Press; 2 edition, 2003
3. Applied Gas Dynamics, by E.Rathakrishnan, John Wiley & Sons (Asia) Pvt Ltd, 2010.
4. Aircraft Gas Turbine Engine Technology,3rd ed., by I.E. Treager, 1995, Glencoe McGraw- Hill, Inc.

AER18R409	HELICOPTER AERODYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

Facilitate students to determine the geometry parameters of main rotor, analyze the aerodynamic characteristics of main rotor blade.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Determine the geometry parameters of main rotor
CO2: Construe the aerodynamic characteristics of main rotor blades
CO3: Characterize the aerodynamic performance of helicopter
CO4: Characterize the static and dynamic stability performance of helicopter at low Mach numbers.
CO5: Infer the vibrational effects of helicopter main rotors.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		2										2		
CO2			2										2		
CO3		2											2		
CO4		2												1	
CO5			3										2		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION

Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls and various types of rotor, Blade loading, Effect of solidity, profile drag, compressibility etc., Blade area required, number of Blades, Blade form, Power losses, Rotor efficiency.

UNIT 2

AERODYNAMICS OF ROTOR BLADE

Aerofoil characteristics in forward flight, Hovering and Vortex ring state, Blade stall, maximum lift of the helicopter calculation of Induced Power, High speed limitations; parasite drag, power loading, ground effect

UNIT 3

POWER PLANTS AND FLIGHT PERFORMANCE

Piston engines, Gas turbines, Ramjet principle, Comparative performance, Horsepower required, Range and Endurance, Rate of Climb, Best Climbing speed, Ceiling in vertical climb, Autorotation.

UNIT 4

STABILITY AND CONTROL

Physical description of effects of disturbances, Stick fixed Longitudinal and lateral dynamic stability, lateral stability characteristics, control response. Differences between stability and control of airplane and helicopter.

UNIT 5

ROTOR VIBRATIONS

Dynamic model of the rotor, Motion of the rigid blades, flapping motion, lagging motion, feathering motion, Properties of vibrating system, phenomenon of vibration, fuselage response, vibration absorbers, Measurement of vibration in flight. Rotor Blade Design: General considerations, Airfoil selection, Blade construction, Materials, Factors affecting weight and cost, Design conditions, Stress analysis.

Text Books:

1. John Fay, Helicopter: history, piloting and How It Flies, Himalayan Books 1995.
2. Lalit Gupta, Helicopter Engineering; Himalayan Books New Delhi 1996.

References:

1. Joseph Schafer, Basic Helicopter Maintenance (Aviation Technician Training Course-JS312642), Jeppesen 1980.
2. R W Prouty, Helicopter Aerodynamics, Phillips Pub Co, 1993.

AER18R410	HYPERSONIC AERODYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

Enable the students to estimate lift coefficient, examine the high temperature effects on airframe.

Course Outcomes:

After completing this course, the student will be able to:

CO1: differentiate hypersonic aerodynamics from supersonic aerodynamics
CO2: Estimate lift co-efficient using Newtonian theory.
CO3: Infer the effect of boundary layer and aerodynamic heating on airframe
CO4: Summarize viscous interaction in hypersonic flow
CO5: Examine the high temperature effects on airframe

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												1		
CO2	2												1		
CO3	2												1		
CO4	1			3											2
CO5	1			3											2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FUNDAMENTALS OF HYPERSONIC AERODYNAMICS

Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

UNIT 2

SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS

Local surface inclination methods – Newtonian theory – modified Newtonian law tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory- blast wave theory-hypersonic equivalence principle

UNIT 3

VISCOUS HYPERSONIC FLOW THEORY

Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self-similar boundary layers – solution methods for non self-similar boundary layers – aerodynamic heating and its adverse effects on airframe.

UNIT 4

VISCOUS INTERACTIONS IN HYPERSONIC FLOWS

Introduction to the concept of viscous interaction in hypersonic flows - Strong and weak viscous interactions - hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.

UNIT 5

HIGH TEMPERATURE EFFECTS IN HYPERSONIC FLOWS

Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb's free energy and entropy - chemically reacting boundary layers – recombination and dissociation.

Text Books:

1. John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", AIAA; 2ndEdition, 2006

References:

1. John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", McGraw Hill Publishing Company, 3rd edition,, 2002.
2. John T. Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc., Washington.D.C., 1994.

AER18R411	SATELLITE TECHNOLOGY	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

Facilitate students to examine the structural configurations and to select the materials for satellite.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Define the stabilization axis, spacecraft orbits
CO2: Ensure the orbit orientation of satellites
CO3: Examine the structural configurations and to select the materials for satellite
CO4: Estimate moment co-efficient for trajectory controls
CO5: Outline the ground control systems to control the spacecraft

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		1										1		
CO2	1		2										1		
CO3	1		2										2		
CO4	1			2									2		
CO5	1			2									1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION TO SATELLITE SYSTEMS

Common satellite applications and missions – Typical spacecraft orbits – Definitions of spin the three axis stabilization-Space environment – Launch vehicles – Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics).

UNIT 2

ORBITAL MECHANICS

Fundamental of flight dynamics – Time and coordinate systems – Orbit determination and prediction – Orbital maneuvers – GPS systems and application for satellite/orbit determination – Ground station network requirements

UNIT 3

SATELLITE STRUCTURES & THERMAL CONTROL

Satellite mechanical and structural configuration: Satellite configuration choices, launch loads, separation induced loads, deployment requirements – Design and analysis of satellite structures – Structural materials and fabrication – The need of thermal control: externally induced thermal environment – Internally induced thermal environment - Heat transfer mechanism: internal to the spacecraft and external heat load variations – Thermal control systems: active and passive methods.

UNIT 4

SPACECRAFT CONTROL

Control requirements: attitude control and station keeping functions, type of control maneuvers – Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization – Commonly used control systems: mass expulsion systems, momentum exchange systems, gyro and magnetic torque - Sensors star and sun sensors, earth sensor, magnetometers and inertial sensors

UNIT 5

POWER SYSTEM AND BUS ELECTRONICS

Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency – Space battery systems – battery types, characteristics and efficiency parameters – Power electronics. Telemetry and telecommand systems: Tm & TC functions, generally employed communication bands (UHF/VHF, S, L, Ku, Kaetc), their characteristics and applications- Coding Systems – Onboard computer- Ground checkout Systems.

Text Books:

1. Analysis and Design of Flight Vehicle Structures, Tri-State off set company, USA, 1980.
2. Space Systems Engineering Rilay, FF, McGraw Hill, 1982.
3. Principles of Astronautics Vertregt.M.,Elsevier Publishing Company, 1985.
4. Introduction Space Flight, Francis J. Hale Prentice Hall, 1994.

References:

1. Spacecraft Thermal Control, Hand Book, Aerospace Press, 2002.
2. Structural Design of Missiles & Space Craft Lewis H. Abraham, McGraw Hill, 92.
3. Space Communications Systems, Richard.F, FilipowskyEugen I Muehllorf, Prentice Hall, 1995.
4. Hughes, P.C. Spacecraft Altitude Dynamics, Wilsey, 1986.
5. Space Vehicle Design, Michael D. Griffin and James R. French, AIAA Education Series, 1991.

AER18R412	SPACE MECHANICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

Facilitate students explain the laws for planetary motion, evaluate influence coefficient, perturbation velocity.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Describe the space environment, its effect on materials
CO2: Explain the laws for planetary motion.
CO3: Evaluate the perturbation velocities using Cowell's method and Encke's method.
CO4: Interpret the interplanetary trajectory motion
CO5: Infer the influence co-efficient on ballistic missile trajectory

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												2		
CO2	2												2		
CO3														2	
CO4															
CO5															

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

SPACE ENVIRONMENT

Peculiarities of space environment and its description– effect of space environment on materials of spacecraft structure and astronauts- manned space missions – effect on satellite life time

UNIT 2

BASIC CONCEPTS AND THE GENERAL N- BODY PROBLEM

The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler's laws of planetary motion and proof of the laws – Newton's universal law of gravitation - the many body problem - LagrangeJacobi identity – the circular restricted three body problem – libration points – the general N-body problem – two body problem – relations between position and time.

UNIT 3

SATELLITE INJECTION AND SATELLITE PERTURBATIONS

General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell's method and Encke's method – method of variations of orbital elements – general perturbations approach.

UNIT 4

INTERPLANETARY TRAJECTORIES

Two-dimensional interplanetary trajectories – fast interplanetary trajectories – three dimensional interplanetary trajectories – launch of interplanetary spacecraft – trajectory estimation about the target planet – concept of sphere of influence – Lambert's theorem

UNIT 5

BALLISTIC MISSILE TRAJECTORIES

Introduction to ballistic missile trajectories – boost phase – the ballistic phase – trajectory geometry – optimal flights – time of flight – re-entry phase – the position of impact point – influence coefficients

Text Books:

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamics", J.W. Freeman&Co.,Ltd, London, 1982
2. Parker, E.R., "Materials for Missiles and Spacecraft", Mc.Graw Hill Book Co. Inc., 1982.

References:

1. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons; 8th Edition 2010

AER18R413	THEORY OF ELASTICITY	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

To study the behavior of various aircraft structural components under different types of loads.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Formulate stress tensor matrix, find its components
CO2: Estimate stress components using Airy's stress function
CO3: Derive the equations of equilibrium for rotating discs
CO4: Determine polar moment of inertia for shafts with cross section such as circular, elliptical, equilateral triangle
CO5: Derive the equation of equilibrium for plates and shells with different loading conditions.

Mapping of Course Outcome(s):

CO / PO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	3	2														
CO2		3														
CO3	3															
CO4		2		2										2		
CO5	3															

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

BASIC EQUATIONS OF ELASTICITY

Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants

UNIT 2

PLANE STRESS AND PLANE STRAIN PROBLEMS

Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.

UNIT 3

POLAR COORDINATES

Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.

UNIT 4

TORSION

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.

UNIT 5

INTRODUCTION TO THEORY OF PLATES AND SHELLS

Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions

Text Books:

1. Timoshenko, S.P, and Goodier, T.N., Theory of Elasticity, McGraw – Hill Ltd., Tokyo, 1990.
2. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey,4th edition 2003.
3. Bhaskar, K., and Varadan, T. K., Theory of Isotropic/Orthotropic Elasticity, CRC Press USA, 2009.

References:

1. Wang, C. T., Applied Elasticity, McGraw – Hill Co., New York, 1993.
2. Sokolnikoff, I. S., Mathematical Theory of Elasticity, McGraw – Hill, New York, 1978.
3. Volterra& J.H. Caines, Advanced Strength of Materials, Prentice Hall, New Jersey, 1991
4. Barber, J. R., Elasticity (Solid Mechanics and Its Applications), Springer publishers, 3rd edition,2010.

AER18R414	THEORY OF VIBRATIONS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

Vibration and Aero Elasticity's deals with the motion of aircraft motions alongside their interactions and their vibrations

Course Outcomes:

After completing this course, the student will be able to:

CO1: Examine the frequency of damped and un-damped mechanical systems
CO2: Interpret the natural frequency of multi degree of freedom systems through linear algebra
CO3: Estimate the frequency of beams and shafts
CO4: Compare the natural frequency of the system by different approximate methods
CO5: Interpret the structural and aerodynamic factor that influences the aerodynamic problems

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	3												2	
CO2	1	3												2	
CO3	1	3		1										2	
CO4		2	2	2										1	
CO5		2		3											2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

SINGLE DEGREE OF FREEDOM SYSTEMS

Introduction to simple harmonic motion, D'Alembert's Principle, Free vibrations – Damped vibrations – Forced Vibrations, with and without damping – support excitation – Transmissibility - Vibration measuring instruments

UNIT 2

MULTI DEGREES OF FREEDOM SYSTEMS

Two degrees of freedom systems - Static and Dynamic couplings - vibration absorber- Principal co-ordinates - Principal modes and orthogonal conditions - Eigen value problems - Hamilton's principle - Lagrangean equations and application

UNIT 3

CONTINUOUS SYSTEMS

Vibration of elastic bodies - Vibration of strings – Longitudinal, Lateral an d Torsional vibrations.

UNIT 4

APPROXIMATE METHODS

Approximate methods - Rayleigh's method - Dunkerlay's method – Rayleigh-Ritz method, Matrix Iteration method

UNIT 5

ELEMENTS OF AEROELASTICITY

Coupled flexural–Torsional oscillation of beam- Aeroelastic problems - Collars triangle – Wing Divergence - Aileron Control reversal – Flutter – Buffeting. – Elements of servo elasticity

Text Books:

1. Leonard Meirovitch, 'Elements of Vibration Analysis' – McGraw HillInternational Edition,2007
2. G.K.Grover, "Mechanical Vibrations", 7th Edition, Nem Chand Brothers,Roorkee, India,2009
3. William T. Thomson & Marie Dillon Dahleh, 'Theory of Vibration with Application",Prentice Hall publishers, 5th edition, 1997

References:

1. William Weaver, Stephen P. Timoshenko, Donovan H. Young, Donovan H.Young. 'Vibration Problems in Engineering' – John Wiley and Sons, New York, 2001
2. Bisplinghoff R.L., Ashely H and Hogman R.L., Aero elasticity – Addison Wesley Publication, New York, 1983.
3. William W Seto, 'Mechanical Vibrations' – McGraw Hill, Schaum Series.
4. TSE. F.S., Morse, I.F., Hinkle, R.T., 'Mechanical Vibrations' – Prentice Hall, New York, 1984.
5. Den Hartog, 'Mechanical Vibrations' Crastre Press, 2008.

AER18R415	EXPERIMENTAL AERODYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To determine the stress and strain in materials and structure subjected to static or dynamic forces or loads

Course Outcomes:

After completing this course, the student will be able to:

CO1: Interpret basic measuring techniques and various measuring instruments in fluid mechanics
CO2: Comprehend the operation of wind tunnels, and experiment with the performance of wind tunnels.
CO3: Determine the fluid flow properties using flow visualization techniques
CO4: Demonstrate the pressure, velocity, and temperature measurements
CO5: Examine the special flows and uncertainty analysis

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												1		
CO2	2			1									1		
CO3	1			1										2	
CO4	3	1		2											2
CO5	2												1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

BASIC MEASUREMENTS IN FLUID MECHANICS

Objective of experimental studies – Fluid mechanics measurements – Properties of fluids – Measuring instruments – Performance terms associated with measurement systems – Direct measurements - Analogue methods – Flow visualization – Components of measuring systems – Importance of model studies

UNIT 2

WIND TUNNEL MEASEUREMENTS

Characteristic features, operation and performance of low speed, transonic, supersonic and special tunnels - Power losses in a wind tunnel – Instrumentation and calibration of wind tunnels – Turbulence- Wind tunnel balance – Wire balance – Strut-type – Platform-type – Yoke-type – Pyramid type – Strain gauge balance – Balance calibration

UNIT 3

FLOW VISUALIZATION AND ANALOGUE METHODS

Visualization techniques – Smoke tunnel – Hele-Shaw apparatus - Interferometer – Fringe-Displacement method – Schlieren system – Shadowgraph - Hydraulic analogy – Hydraulic jumps – Electrolytic tank

UNIT 4

PRESSURE, VELOCITY AND TEMPERATUREMEASUREMENTS

Pitot - static tube characteristics - Velocity measurements - Hot-wire anemometry – Constant current and Constant temperature Hot-Wire anemometer – Pressure measurement techniques - Pressure transducers – Temperature measurements

UNIT 5

SPECIAL FLOWS AND UNCERTAINTY ANALYSIS

Experiments on Taylor-Proudman theorem and Ekman layer – Measurements in boundary layers - Data acquisition and processing – Signal conditioning – Uncertainty analysis – Estimation of measurement errors – External estimate of the error – Internal estimate of the error – Uncertainty calculation - Uses of uncertainty analysis

Text Books:

1. Rathakrishnan, E., “Instrumentation, Measurements, and Experiments in Fluids,” CRCPress – Taylor & Francis, 2007
2. Robert B Northrop, “Introduction to Instrumentation and Measurements”,Second Edition, CRC Press, Taylor & Francis, 2006.

AER18R416	WIND TUNNEL TECHNIQUES	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

Wind tunnel techniques course depicts the types, working and characteristics of wind tunnels in the laboratory. The flow characteristics, flow visualization in the tunnel are recorded for further observations.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Determine the Non dimensional numbers
CO2: Classify the wind tunnels, and estimate wind tunnel sizing parameters.
CO3: Calibrate the low and high speed wind tunnels
CO4: Measure the fundamental flow properties using conventional equipment's
CO5: Outline the working principle of high speed tunnels

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												1		
CO2	1												1		
CO3				2											2
CO4	2	2		1											2
CO5	1												1		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

PRINCIPLES OF MODEL TESTING

Buckingham Theorem – Non dimensional numbers – Scale effect – GeometricKinematic and Dynamic similarities.

UNIT 2

TYPES AND FUNCTIONS OF WIND TUNNELS

Classification and types – special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

UNIT 3

CALIBRATION OF WIND TUNNELS

Test section speed – Horizontal buoyancy – Flow angularities – Flow uniformity &turbulence measurements – Associated instrumentation – Calibration of subsonic &supersonic tunnels.

UNIT 4

CONVENTIONAL MEASUREMENT TECHNIQUES

Force measurements and measuring systems – Multi component internal and external balances – Pressure measurement system - Steady and Unsteady Pressure- single and multiple measurements

- Velocity measurements – Intrusive and Non-intrusive methods – Flow visualization techniques-surface flow, oil and tuft - flow field visualization, smoke and other optical and nonintrusive techniques.

UNIT 5

SPECIAL WIND TUNNEL TECHNIQUES

Intake tests – store carriage and separation tests - Unsteady force and pressure measurements – wind tunnel model design

Text Books:

1. Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.
2. NAL-UNI Lecture Series 12: Experimental Aerodynamics, NAL SP 98 01April,1998

References:

1. Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.
2. Bradsaw Experimental Fluid Mechanics. Short term course on Flow visualization techniques, NAL , 2009
3. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008NAL, Bangalore

AER18R417	EXPERIMENTAL STRESS ANALYSIS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

To determine the stress and strain in materials and structures subjected to static or dynamic forces or loads.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Measure the deflection in the structure using extensometers
CO2: Determine the stress at a point in the structure using strain gauges
CO3: Show the stress pattern using photo elastic materials
CO4: Interpret the effect of coating on stress components
CO5: Test and find the crack in the specimen using different NDT techniques.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3			1											2
CO2	2				1								1		
CO3		2	1												1
CO4		2		2											2
CO5	3			2									2		2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

EXTENSOMETERS AND DISPLACEMENT SENSORS

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages, Capacitance gauges, Laser displacement sensors.

UNIT 2

ELECTRICAL RESISTANCE STRAIN GAUGES

Principle of operation and requirements, Types and their uses, Materials for strain gauges, Calibration and temperature compensation, cross sensitivity, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators, Rosette analysis, stress gauges, load cells, Data acquisition, six component balance.

UNIT 3

PHOTOELASTICITY

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission photoelasticity, Jones calculus, plane and circular polariscopes,

Interpretation of fringe pattern, Calibration of photoelastic materials, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT 4

BRITTLE COATING AND MOIRE TECHNIQUES

Relation between stresses in coating and specimen, use of failure theories in brittle coating, Moire method of strain analysis.

UNIT 5

NON – DESTRUCTIVE TESTING

Fundamentals of NDT, Acoustic Emission Technique, Radiography, Thermography,Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing,

Text Books:

1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi, 1984.
3. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2009.

References:

1. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1972.
2. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall, 1993.
3. Max Mark Frocht, Photo Elasticity, John Wiley and Sons Inc., New York, 1968
4. A.J.Durelli, Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970
5. Ramesh, K., Digital Photoelasticity, Springer, New York, 2000.

AER18R418	CRYOGENIC ENGINEERING	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To make students acquire knowledge in Cryogenic Systems and cryogenic power generation.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Know the properties of Cryogenic Fluids.
CO2: Understand the concepts of Gas separation and Purification systems
CO3: Know the method of Cryogenics measurement systems
CO4: Design Cryogenic Fluid Storage Systems
CO5: Apply the concepts of Cryogenic Engineering for various applications

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2			3									2		
CO2	2		1										2		
CO3	2														
CO4	2		1										2		
CO5	2												2		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

Introduction to Cryogenic Systems

Introduction to Cryogenic Systems, Properties of materials at low temperature, Properties of Cryogenic Fluids, Air and Gas Liquefaction Systems: Thermodynamically ideal system, Production of low temperatures, Liquefaction systems for gases other than Neon, Hydrogen and Helium, liquefaction systems for Neon, Hydrogen and Helium, Cryogenic Refrigeration System

UNIT 2

Gas Separation and Gas Purification Systems

Gas Separation and Gas Purification Systems, The thermodynamically ideal separation system properties of mixtures, Principles of gas separation, air separation systems, Hydrogen, Argon, Helium air separation systems, Gas purification methods

UNIT 3

Vacuum Techniques

Vacuum Techniques, System for production of high vacuum such as mechanical, diffusion, ion and cryopumps. Cryogenics measurement systems, Temperature pressure, flow rate, liquid level measurement, Introduction to Cryocoolers.

UNIT 4

Cryogenic Fluid Storage Systems

Cryogenic Fluid Storage Systems, Introduction, Basic Storage vessels, inner vessel, outer vessel design, piping, access manways, safety device, Cryogenic insulations, Vacuum insulation, gas filled powders and fibrous materials, solid foam, selection and comparison of insulations. Cryogenic fluid transfer systems. Transfer through uninsulated lines, vacuum insulated lines, porous insulated lines etc.

UNIT 5

Advances in Cryogenics

Advances in Cryogenics, Vortex tube and applications, Pulse tube refrigerator, Cryogenic Engine for space vehicles, Cryogenic Applications, Applications in gas industry, cryogenic fluids, space research, Cryobiology, food processing, electronics, nuclear and high energy physics, chemical processing, metal manufacturing, cryogenic power generation, medicine, analytical physics and chemistry

Text Books:

1. Fundamentals of Cryogenic Engineering - Mukhopadhyay and Mamata – 2010.
2. Cryogenic Engineering – R.B. Scott – D.Van Nostrand Company, 1959

References:

1. John F Wendt (Ed.), “Computational Fluid Dynamics – An Introduction”, Third Edition, Springer- Verlag, Berlin Heidelberg, 2009.
2. H.K. Versteeg and W. Malalsekera “An Introduction to Computational Fluid Dynamics, The Finite Volume Method”, PHI; 2 edition 2007.
3. T. J. Chung, “Computational Fluid Dynamics”, Cambridge University Press; 2 edition (27 September 2010)
4. C. Hirsch, “Numerical Computation of Internal and External Flows” Volume-2, John Wiley and Sons, 1994
5. Joel H. Ferziger & Milovan Peric, “Computational Methods for Fluid Dynamics” Springer; 3rd ed. 2002 edition 2001.

AER18R419	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	1	4
Course Category	Major Elective				
Course Type	Theory				

Course Objective:

To make the students to understand the basic concepts of fluid dynamics and to set a clear picture of the condition of a flow in real motion

Course Outcomes:

After completing this course, the student will be able to:

CO1: Describe the flow phenomena in a flow field with correspondence with elliptic, parabolic and hyperbolic equations
CO2: Explain the steps involved in source and panel methods
CO3: Describe the upwind concept and its effects in a given flow. Interpret the discretization of a flow model for analysis
CO4: Apply the weighted variational formulae and Galerkin method for finite volume technique
CO5: know the numerical finite volume methods in computational analysis

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2		1										1	1	
CO2		3	1	3										2	
CO3		3												1	
CO4	2													1	
CO5	1													3	

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION TO NUMERICAL METHODS IN FLUID DYNAMICS

Introduction to numerical fluid dynamics - Introduction to governing equations of fluid dynamics and modeling of fluid flow – The substantial derivative and the physical meaning of divergence of a vector. Boundary conditions for various types of fluid flow conditions - Introduction to mathematical properties of fluid dynamic equations and classification of partial differential equations - General behaviour of different classes of partial differential equations and their relation to fluid dynamics - A general discussion on hyperbolic, parabolic and elliptic equations

UNIT 2

SOLUTION OF FLUID FLOW EQUATIONS

Introduction to boundary layer equations and their solution - Discretization of the boundary layer equations and illustration of solution– Solution methods for elliptic, parabolic and hyperbolic equations-velocity potential equation

UNIT 3

GRID GENERATION

Introduction to grid generation in computational fluid dynamics - Structured grid generation techniques – algebraic methods, conformal mapping and methods using partial differential equations - Basic ideas in numerical grid generation and mapping - Boundary value problem of numerical grid generation- grid control functions- branch cut - The boundary conditions of first kind– orthogonality of grid lines- boundary point grid control.

UNIT 4

TIME DEPENDENT METHODS

Introduction to time dependent methods - Explicit time dependent methods –Description of Lax- Wendroff Scheme and Mac Cormack's two step predictor – corrector method - Description of time split methods. Introduction to implicit methods and respective stability properties of explicit and implicit methods - Construction of implicit methods for time dependent problems - Linearization, choice of explicit operator and numerical dissipation aspects

UNIT 5

FINITE VOLUME METHOD

Introduction to Finite volume Method - Different Flux evaluation schemes, central, upwind and hybrid schemes - Staggered grid approach - Pressure-Velocity coupling - SIMPLE, SIMPLER algorithms- pressure correction equation (both incompressible and compressible forms) - Application of Finite Volume Method -artificial diffusion

Text Books:

1. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 1" Springer Verlag,1996.
2. C.A.J. Fletcher, "Computational Techniques for Fluid Dynamics 2", Springer Verlag, 1995

References:

1. John F Wendt (Ed.), "Computational Fluid Dynamics – An Introduction", Third Edition, Springer-Verlag, Berlin Heidelberg, 2009.
2. H.K. Versteeg and W. Malalsekera "An Introduction to Computational Fluid Dynamics, The Finite Volume Method", PHI; 2 edition 2007.
3. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press; 2 edition (27 September 2010)
4. C. Hirsch, "Numerical Computation of Internal and External Flows" Volume-2, John Wiley and Sons, 1994
5. Joel H. Ferziger&MilovanPeric, "Computational Methods for Fluid Dynamics" Springer; 3rd ed. 2002 edition 2001.

AER18R420	COMPOSITE MATERIALS AND STRUCTURES	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Major elective				
Course Type	Theory				

Course Objective:

Analysis and design of composite structures using Moulding methods of construction, fabrication to evaluate and understand the concepts of laminated plate

Course Outcomes:

After completing this course, the student will be able to:

CO1: Determine the elastic moduli of composite structures
CO2: Identify the number of elastic constants for different composite materials.
CO3: Analyze sandwich and laminated plates
CO4: Demonstrate the fabrication and repair techniques of composite materials
CO5: construct and analysis different composite technique

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2													1
CO2	1	2													1
CO3	2			2									1		
CO4	1		1	2	1										2
CO5	1		2	2											2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

MICROMECHANICS

Introduction - Advantages and application of composite materials – Types of reinforcements and matrices - Micro mechanics – Mechanics of materials approach, elasticity approach- Bounding Techniques – Fiber Volume ratio – Mass fraction – Density of composites. Effect of voids in Composites.

UNIT 2

MACROMECHANICS

Generalized Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials - Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of In plane strengths of a lamina - Experimental characterization of lamina. Failure theories of a lamina. Hygrothermal effects on lamina.

UNIT 3

LAMINATED PLATE THEORY

Governing differential equation for a Laminate. Stress – Strain relations for a laminate. Different types of laminates. In plane and Flexural constants of a laminate. Hygrothermal stresses and strains

in a laminate. Failure analysis of a laminate. Impact resistance and Interlaminar stresses. Netting analysis

UNIT 4

FABRICATION PROCESS AND REPAIR METHODS

Various open and closed mould processes, Manufacture of fibers, Importance of repair and different types of repair techniques in Composites – Autoclave and non-autoclave methods.

UNIT 5

SANDWICH CONSTRUCTIONS

Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Bending stress and shear flow in composite beams.

Text Books:

1. Isaac M. Daniel &OriIshai , "Mechanics of Composite Materials," OUP USA publishers, 2ndedition, 2005.
2. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 2nd edition, 2005.
3. MadhujitMukhopadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

References:

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley & Sons, 3rd edition, July 2006.
2. Lubing, Handbook on Advanced Plastics and Fibre Glass, Von Nostran Reinhold Co., New York, 1989.
3. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998.
4. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, 2ndEdition, 2004.

HUMANITITES ELECTIVES

HSS18R001	MANAGEMENT CONCEPTS AND TECHNIQUES	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course addresses the definition of management, its characteristics, evolution and importance as well as the functions performed by manages-planning, organizing, directing and controlling. The course also intends to show students the applications of management functions in various enterprises such as marketing, finance, personnel, production, etc.

Course Outcomes:

After completing this course, the student will be able to:

CO1: To Explain the historical backdrop and fundamentals of Management thoughts vital for understanding the conceptual frame work of Management as a discipline.

CO2: To Discuss about the various concepts of planning, Decision making and controlling to help solving managerial problems

CO3: To Understanding concepts of Ethics, Delegation, Coordination and Team work

CO4: To Study and understand the management concepts and styles in Global context

CO5: To develop an understanding about emerging concepts in management thought and philosophy

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						2						1			
CO2							2	2	1	1					
CO3						1		3	3	2					
CO4						3	2			1					
CO5							3					3			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

DEVELOPMENT OF MANAGEMENT THOUGHTS

Scientific Management Movement - Administrative Movement - Human Relations Movement - Decision Movement - Behavioural Science Movement - Systems Movement - Contingency Movement.

UNIT 2

ESSENTIALS OF PLANNING

Planning Objectives – Goals - Programmed Decisions and Unprogrammed Decisions; Decision – Making - Creativity in Decision - Making, Forecasting and Strategy to Formulation

UNIT 3

EFFECTIVE ORGANISING

Span of Control – Departmentation - Authority; Responsibility - Bureaucracy and Adhocracy; Group Dynamics

UNIT 4

STAFFING AND DIRECTING

Staffing: Manpower Planning – Recruitment Sources – Selection Procedure – Training Methods – Performance Evaluation Methods – Executive Development Programs - Directing: Communication Process and Barriers – Motivation Techniques – Financial and Non – Financial Motivation- Leadership Qualities and Styles

UNIT 5

CONTROLLING AND RECENT CONCEPTS

Controlling: Meaning and Process - Requisites of Effective Control - Control Techniques. Emerging Issues in Management: Japanese and American Management – Management by Objectives – Knowledge Management – Technology Management – Business Process Outsourcing- Social Responsibility and Business Ethics

Text Books:

1. Harold Koontz, Heinz Weihrich, Essentials of Management: An International, Innovation and Leadership Perspective, 10th Edition, McGraw Hill, 2016

2. Stephen P. Robbins, Mary A. Coulter, Management, 13th Edition, Pearson Education Limited, New Delhi, 2016

References:

1. C.B.Gupta, Management Theory and Practice, 19th Revised Edition, Sultan Chand and Sons.2017.

2. L.M.Prasad, Principles and Practices of Management, 9th Edition, Sultan Chand and Sons, 2015.

3. K.Aswathappa, Essentials of Business Environment: Text Cases and Exercises 12th, edition, Himalaya Publishing House, Mumbai, 2014.

4. Tripathi, Reddy, Principles of Management, 5th Edition, McGraw Hill, 2012

HSS18R002	MARKETING MANAGEMENT	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course develops students understanding of how organizations match the requirements of consumers in competitive environments, and develop strategies to create the competitive edge. It covers areas such as analysis, planning, implementation, and control, as well as the marketing mix, exportation, and the social aspects of marketing.

Course Outcomes:

After completing this course, the student will be able to:

CO1: To Develop understanding of marketing concepts, philosophies and historical background.

CO2: To Develop understanding of marketing operations and complexities for students to apply in practical business situations.

CO3: To Understand concepts related to Segmentation, Targeting and Positioning, product attributes, and pricing strategies prevalent in domestic and international scenario.

CO4: To Study various tools and techniques of promoting the products in ethical manner.

CO5: To Understand emerging concepts of marketing in the emerging global markets

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						2	1					1			
CO2							2	2	1	1					
CO3						1		3							
CO4						3	2	3	1	1					
CO5							3					3			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

MARKETING

Meaning - concept - functions - marketing Planning and implementation marketing Programmes - Marketing environment – Market Segmentation and consumer behaviour – Influencing factors, Decision process –Marketing mix – Marketing department

UNIT 2

PRODUCT

Meaning - Product planning - policies - positioning - New product development Product life cycle – BCG Matrix - branding. Packing, labelling

UNIT 3

PRICING

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

UNIT 4

DISTRIBUTION

Nature of Marketing channels - Types of Channel flows – Channel functions - Channel co-operation, conflict and competition - Direct Marketing Telemarketing, Internet shopping

UNIT 5

PROMOTION

Promotion Mix - Advertisement - Message - copy writing – Advertisement - budgeting - Measuring advertisement effectiveness - Media strategy - sales promotion - Personal selling steps, publicity and direct marketing

Text Books:

1. Philip.T. Khotler, Kevin Lane Keller, Marketing Management, 15th Edition, Pearson Education, New Delhi, 2016.
2. Ramaswamy.VS, Namakumari. S, Marketing Management – Global Perspective, Indian Context, McGraw Hill, 2013
1. RajanSaxena, Dorector, Jain S.P., Marketing Management, McGraw Hill, 2006.
2. K.S. Chandrasekar, Marketing Management, Text and Cases, McGraw hill 2013.
Tapan K. Panda, Marketing Management Text and Cases, 2nd Edition, Excel Books.2008.

References:

1. RajanSaxena, Dorector, Jain S.P., Marketing Management, McGraw Hill, 2006.
2. K.S. Chandrasekar, Marketing Management, Text and Cases, McGraw hill 2013.

HSS18R003	ORGANISATIONAL PSYCHOLOGY	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

The course aims to clarify the principles and basic concepts of organizational psychology. Including organizations and understanding its business design based on efficiency and quality of employee life. It also aims at enhancing the quality of life of employees. When organization's aspects are gauged in terms of psychological assessment, personnel decisions in line with training and development, organizational change and organizational health in specific the intrinsic problems are understood paving way towards standards that are high.

Course Outcomes:

After completing this course, the student will be able to:

CO1: To learn basic concepts of industrial and organisational psychology

CO2: To illustrate different ways of achieving organisational effectiveness through individual behaviour.

CO3: To learn the concepts relating to individual behaviour to achieve group target and achieve leadership position in organisation.

CO4: To understand the organisational changes and means to evaluate based on nature of organisations.

CO5: To learn implications of changes aligning the interest of individual, group and organisation.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						2		1	2						
CO2						1		1	2	2					
CO3						1		1	2	3					
CO4						1	1	1	1	1					
CO5						1	1	1				1			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FOCUS AND PURPOSE

Organisational Behaviour - Need and importance, nature and scope, framework

UNIT 2

INDIVIDUAL BEHAVIOUR

Personality – types – factors influencing personality – theories – learning – types of learners – learning theories – organizational Behaviour modification. Attitudes – characteristics – components – formation – measurement. Perceptions – importance – factors influencing perception – interpersonal perception

UNIT 3

GROUP BEHAVIOUR

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

UNIT 4

LEADERSHIP

Leadership styles – theories – Qualities - leaders Vs managers – sources of power – power centres – power and Organisational Politics- Motivation

UNIT 5

ORGANISATIONAL DEVELOPMENT

Organizational development - Importance, characteristics, objectives, stability Vs change, proactive vs reaction change, the change process, resistance to change, managing change, team building - Organizational effectiveness, perspective, effectiveness Vs efficiency, approaches, the time dimension, achieving organizational effectiveness

Text Books:

1. Stephen Probing and Timothy A. Judge, Organisational Behavior, Peason Education, 17th edition, 2017.
2. Fred Luthans, Organisational Behavior, McGraw Education, 12th Edition, 2010

References:

1. Aswathappa, Organisational Behavior, Himalaya Publishing House, 12th edition, 2016.
2. P.Subba Rao, Management and Organisational behavior: Text, Cases and Games, Himalaya Publishing House, 1st edition, 2010.
3. Mullins, Organisational Behavior, Pearson Education Limited, 9th edition, 2010.
4. L.M.Prasad, Organisational Behavior, 5th edition, Sultan Chand and Sons, New Delhi, 2014.

HSS18R004	PROJECT MANAGEMENT	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course describes concepts relating to project management and enable students to evolve project objectives appropriately with relevance to business proposals. It covers the required dimensions relating to evaluation of project by testing the technical feasibility, financial viability, market acceptability and social desirability of projects. It gives an account on risk and profitability analysis that facilitates the making of the effective project proposal and guides learners in project planning, implementation and control. It also emancipates the scope of project management in undertaking foreign collaboration projects.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Familiarizes the concept of project and steps in project management
CO2: Understand the basics stages involved in preparing business proposals.
CO3: Evaluate the technical feasibility, financial viability, market acceptability and social desirability of projects.
CO4: Enabled to analyse the Risk and profitability of the project proposals
CO5: Act effectively as project managers and as part of project teams

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1		1	2	3	1			
CO2						1		1	3	3	1				
CO3						3		1	1	1	3				
CO4						1	1	1	1	1	3	1			
CO5						1		1	3	1	1	1			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION TO PROJECT MANAGEMENT 9 Hours

Projects - Project ideas and preliminary screening. Developments - Project planning to Project completion - Pre-investment phase, Investment phase, operational phase - Governmental Regulatory framework. Capital Budgeting

UNIT 2

STAGES OF PROJECT MANAGEMENT 9 Hours

Opportunity studies - prefeasibility studies, functional studies or support studies, feasibility study expansion projects, data for feasibility study. Market and Technical Appraisal: Market and

Demand analysis, Market Survey, Demand forecasting. Technical analysis- Materials and inputs, Choice of Technology, Product mix, Plant location, capacity, Machinery and equipment

UNIT 3

APPRAISAL PROCESS 9 Hours

Concepts. Time value of money - Present and future value. Appraisal criteria - Urgency, Payback period, Rate of return, Debt service coverage ratio, Net present value, Benefit cost ratio, Internal rate of return, Annual capital charge, Investment appraisal in practice

UNIT 4

RISK AND PROFITABILITY ANALYSIS 9 Hours

Risk analysis- Measures of risk, Sensitivity analysis, and Decision tree analysis. Means of financing, Term Loans, Financial Institutions. Cost of capital. Profitability - Cost of Production, Break-even analysis. Assessing the tax burden and financial projections

UNIT 5

PROJECT PLANNING, IMPLEMENTATION AND CONTROL 9 Hours

Forms of Project Organization, Project Planning, Implementation, and Control - Network construction, CPM, PERT, Development of Project schedule, Crashing of Project Network. Introduction to Foreign collaboration projects - Governmental policy framework, Need for foreign technology, Royalty payments, Foreign investments and procedural aspects

Text Books:

1. Prasanna Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation, 8th Edition, McGraw Hill, 2014.
2. M.R. Gopalan, Project Management Core Textbook, 2nd edition, Wiley India, 2015

References:

1. Harold Kerzne, Project Management - Best Practices: Achieving Global Excellence, 3edition, Wiley Publications, 2013
2. George Ritz, Sidney Levy, Project Management in Construction, Sixth Edition, Mc. Graw Hill Education, 2011.
3. Gary Heerkens, Project Management, 2ndEdition, Mc. Graw Hill, 2013
4. P.Gopalakrishnan and V.E.RamaMoorthy Text Book of Project Management,1st Edition, Macmillan India Ltd., New Delhi, 2014.
John M. Nicholas, Herman Steyn, Project Management for Engineering, Business and Technology, 5th Edition, Routledge, 2016.

HSS18R005	STRESS MANAGEMENT AND COPING STRATEGIES	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

Stress has become an integral part of every professional's life. Approaching the stress in the right manner has become imperative as it has become an unavoidable one. The stress and its effect over performance has also become notable in today's organization. To cope well and to sustain in market, for that the skills are required to understand and to overcome the same. This course helps in understanding the intricacies of stress and overcoming the stress through appropriate approaches.

Course Outcomes:

After completing this course, the student will be able to:

CO1: The students understand the responsibility of tackling stress
CO2: The students identify and modify the approaches of stress accordingly while dealing with team in workplace.
CO3: Those students who are prone to face high- pressure working conditions will be able to tackle stress appropriately without ignoring.
CO4: The students will implement a stress -free work environment.
CO5: The students will enrich their way of behaviour and personality and ensure professional working condition and balanced quality of life.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1		1	2		1			
CO2						1		2	3	3					
CO3						2		1	1						
CO4						1	1	1	1	1		1			
CO5						1		1	3	1		1			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

UNDERSTANDING STRESS 9 Hours

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress – Reducing Stress – Burnout

UNIT 2

COMMON STRESS FACTORS TIME 9 Hours

Common Sources of Stress Biological, Personality and Environmental – Time Management – Techniques – Importance of planning the day – Time management schedule – Developing concentration – Organizing the Work Area - Prioritizing – Beginning at the start – Techniques for conquering procrastination – Sensible delegation – Taking the right breaks – Learning to say 'No'

UNIT 3

CRISIS MANAGEMENT 9 Hours

Implications – People issues – Structure issues, environmental issues, psychological fall outs – Learning to keep calm – Preventing interruptions – Controlling crisis – Importance of good communication – Taking advantage of crisis – Pushing new ideas – Empowerment

UNIT 4

WORK PLACE HUMOUR 9 Hours

Developing a sense of Humour – Learning to laugh, role of group cohesion and team spirit, using humour at work, reducing conflicts with humour. Coping Styles Defensive Behaviours and Problem-Solving

UNIT 5

SELF DEVELOPMENT 9 Hours

Improving Personality – Leading with Integrity, enhancing creativity – Effective Decision Making – Sensible Communication – The Listening Game – Managing Self - Meditation for Peace – Yoga for Life

Text Books:

1. D. Gordano and G. Everly., "Controlling Stress and Tension", 9th Edition, Prentice-Hall, 2013.
2. Greenberg Jerrold S., Comprehensive Stress Management, 14th Edition, McGraw Hill Education, 2017.

References:

1. Dr. P.K.Dutta, "Stress Management" Himalaya Publishing House, First Edition 2010.
2. Schafer, Stress Management, 4th Edition, Cengage Learning, Delhi, 2008
3. Wolfgang Linden, Stress Management, Sage Publication, 1st Edition 2005.
4. Daniel Girdano, Dorothy Dusek and George S. Everly, Controlling Stress and Tension, 8th Edition, Pearson Education, 2009.
5. Brian Luke Seaward, Essentials of managing Stress, 1st edition, Jones & Bartlett Publishers, 2013

HSS18R006	ECONOMICS FOR ENGINEERS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course introduces a broad range of economic concepts, theories and analytical techniques. It considers both microeconomics - the analysis of choices made by individual decision-making units (households and firms) - and macroeconomics - the analysis of the economy. Demand and market structure will be analysed at the firm level. Macroeconomic issues regarding National Income, Inflation, labour and money at an aggregate level will be modelled. The role of government policy to address microeconomic market failures and macroeconomic objectives will be examined.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Identify and learn economic concepts into market economies.

CO2: Understand the pricing methods, interpret the market factors to determine the price for products or services and to making decisions based on demand factors.

CO3: Understand the major characteristics of different market structures and the implications for the behaviour of the firm.

CO4: Measure living standards, inflation, and unemployment for use as economic indicators.

CO5: Understand the role of international trade.

CO6: Analyse the determinants of the relative strengths of monetary policy for sustainable growth of our nation and International Trade.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1											3				
CO2						1		1			2				
CO3						1	1		2	1	1				
CO4	3	3									1				
CO5	1							1	1						
											3				

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

DEFINITION AND SCOPE OF ECONOMICS 9 Hours

Meaning - Symptoms: Biological and Behavioural - Work Related Stress - Individual Stress – Reducing StressDefinitions by A. Smith, A. Marshal and L. Robbins, P.Samuels on and their critical examination - Nature and scope of Economics - Micro-economics in relation to other branches of Economics

UNIT 2

PRICING AND LAW OF DEMAND 9 Hours

Demand, Factors influencing demand, Elasticity of demand - price, income and cross, concepts and measurement - Break Even Analysis

UNIT 3

MARKET STRUCTURE 9 Hours

Definition of market. Concepts of product and factor markets. Different types of market: perfect competition, monopoly, imperfect competition, monopolistic, competition and oligopoly. Demand and Supply schedules. Price determination under perfect competition in long and short run. Price determination under monopoly. Discriminating monopoly

UNIT 4

MACRO ECONOMICS 9 Hours

Meaning, Macro-economic Policy and Its Objectives and Instruments - National Income and Social Accounting - Concepts, components, and measurement - Basic circular flow of income model, Unemployment, trade cycle, Inflation - causes, types, effects and control

UNIT 5

COMMERCIAL AND CENTRAL BANKS 9 Hours

Credit creation, monetary policy and tools - Balance of payments - Items in the balance of payments account, equilibrium in the balance of payments

Text Books:

1. Gupta, S.B., Monetary Economics, S. Chand & Co., New Delhi, 2nd Edition, 2009.
2. RuddarDatt and K.P.M. Sundharam, Indian Economy, 70th Edition, S. Chand & Company Ltd., New Delhi, 2013.

References:

1. D.N. Dewedi, Managerial Economics, 8th Edition, S. Chand & Company Ltd., New Delhi, 2005.
2. Gupta, G.S. Macroeconomics, Theory and Applications, 2nd edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2004.
3. Macroeconomic –Theory and policy, 3rd Edition, Tata McGraw-Hill publishing company Ltd., New Delhi, 2010.
4. Micro Economics, Mas Colell, 1st edition, Oxford Press, Delhi, 2012

HSS18R007	HUMAN RESOURCE MANAGEMENT AND LABOUR LAW	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course aims at exploring key issues related to the management, performance, and development of human resources in the workplace. It places special emphasis on making decisions and developing plans that will enable managers to make the best possible use of their human resources, and covers areas such as: manpower planning, analysis and evaluation, recruitment and selection, wages and salaries, training and management development, performance appraisal, and industrial relations.

Course Outcomes:

After completing this course, the student will be able to:

CO1: To provide the basic knowledge on developing the employment relations and knowledge to resolve the issues.

CO2: To design an appropriate and suitable role of HR specialist for implementing Human Resource Management policies.

CO3: To Manage the manpower to motivate and attract them to retain in the organization.

CO4: To Develop the responsibility of employer and legal system to manage the employment relations

CO5: To Provide more insights on the applicability of business law on various functional domains this in turn enhances a strong human relation

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1							1	1	2						
CO2									2	2					
CO3									3	3					
CO4						1		1	1						
CO5						1	1	1	3						

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

FUNDAMENTALS OF HRM 9 Hours

Human Resource Development Systems-HR environment in India-Functions and Operations of a Personnel Office - Emerging HR Trends - HR information system

UNIT 2

HRM FUNCTIONS 9 Hours

Job analysis and job design - HR planning – Recruitment - selection and induction- Staff Training and Development-Career planning and Development- Job Evaluation-Performance Appraisal and Potential Evaluation-Wage determination; salary structure-Wage policies and Regulations-Employee benefits and services.

UNIT 3

MOTIVATING HUMAN RESOURCES 9 Hours

Team and Team work - Collective Bargaining Employee Morale – Participative Management – Quality Circle – Empowerment –counselling and mentoring

UNIT 4

MAINTENANCE OF WORKERS 9 Hours

Compensation Management- Reward system – Labour relations –Employee Welfare, Safety and Health – Employee benefits and services – Promotion, Transfers and separation – Ethical issues in HR Management and International Human Resource Management - Legal Aspect of Labour

UNIT 5

BUSINESS LAW 9 Hours

Factories Act, 1948 - Industrial Dispute Act, 1947 – Industrial employment – Standing Orders Act, 1946 – Trade Union Act, 1926 - Workmen Compensation Act, 1923, Employees State Insurance Act, 1948, Employees Provident Fund and Miscellaneous Provision Act, 1952, Payment of Gratuity Act, 1972. Payment of Wages Act 1936, Minimum wages Act, 1948– Payment of Bonus Act, 1965.Tamil Nadu Shops and Establishments Act.

Text Books:

1. Decenzo and Robbins, Human Resource Management, Wiley, 12th edition, 2015.
2. Prasad L.M., Human Resource Management, Sultan Chand, 2014.

References:

1. BiswajeetPattanayak, Human Resource Management, 3rd edition, Eastern Economy Edition, New Delhi, 2010.
2. C.B. Gupta, Human Resource Management, 13th Edition, Sultan Chand
3. V.S.P. Rao, Human Resource Management, 3rd edition, Excel Books.
4. Frank B. Cross and Roger LeRoy Miller, The Legal Environment of Business Text and cases, 9th Edition, Cengage Learning, 2015.

HSS18R008	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course focuses on the entrepreneurial process and the different kinds of entrepreneurial outcomes. Topics covered include opportunity identification through analysis of industry niches, skills needed to turn an opportunity into reality, business plans, launch decisions, and obtaining risk capital. This course deals with the problems and challenges facing the management of businesses in raising funds, marketing products and services, improving effectiveness and flexibility, and achieving growth.

Course Outcomes:

After completing this course, the student will be able to:

CO1: It provides more insights into the concept of entrepreneurship and which in turn leads to think creatively for new business opportunities to sustain individual as well as social goals.
CO2: It provides and promotes entrepreneurial spirit and provides a framework of successful business world with relation to agencies to promote employment opportunities.
CO3: It focuses on women entrepreneurship and promotes a successful business models and explains operational implementations for investment details.
CO4: It provides the role of government in promoting the entrepreneurship among the individuals and organizations as a whole
CO5: To Understand emerging concepts of marketing in the emerging global markets and provide more insights into project management and venture promotion

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						3	1	1	2	1		1			
CO2						1		1	1						
CO3						2		2	2						
CO4								1	3	1					
CO5							3				1	3			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

BASICS 9 Hours

Concepts of entrepreneur, entrepreneurship and entrepreneur - Characteristics and competencies of a successful entrepreneur - General functions of an entrepreneur - Type of entrepreneurs - Role of entrepreneur in economic development - Distinction between an entrepreneur and a manager - Entrepreneur and Intrapreneur

UNIT 2

GROWTH OF ENTREPRENEURSHIP 9 Hours

Emergence of entrepreneurship - Economic and non-economic factors for stimulating entrepreneurship development - Obstacles to entrepreneurship development in India - Growth of entrepreneurship in India.

UNIT 3

WOMEN AND ENTREPRENEURSHIP 9 Hours

Concept of women entrepreneurship - Reasons for growth of woman entrepreneurship - Problems faced by them and remedial measures

UNIT 4

ROLE OF THE GOVERNMENT IN ENTREPRENEURSHIP DEVELOPMENT 9 Hours

Concept and meaning of entrepreneurship development - Need for entrepreneurship development programmes (EDPs) - Objectives of EDPs - Organizations for EDPs in India; NIESBUD, SISI – their roles and activities.

UNIT 5

VENTURE PROMOTION AND PROJECT FORMULATION 9 Hours

Concept of projects classification of projects and project report - Project identification and selection - Constraints in project identification - Techniques of Project Identification, Significance – contents - formulation of project report - Need for Project Formulation - Elements of project Formulation

Text Books:

1. Michael H Morris, Corporate Entrepreneurship and Innovation in Corporations, 7th Edition, CENGAGE Learning, Delhi, 2010
2. Jerry Katz, Entrepreneurship Small Business, 5th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007

References:

1. Khanka S.S., Entrepreneurial Development, 1st edition, S. Chand and Company Limited, New Delhi, 2013.
2. Prasama Chandra, Projects: Planning, Analysis, Selection, Implementation and Reviews, 2nd edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
3. Robert D. Hisrich, Entrepreneurship, 10th edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

HSS18R009	COST ANALYSIS AND CONTROL	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course in meant to exhibit the concepts on costing by describing its elements, types and cost sheet preparation. It also encompasses the analytical framework that can be applied in cost analysis like Marginal costing, CVP analysis, break even analysis, etc. enabling the students to make decisions on cost parameters. Students are enabled to apply techniques like standard costing, activity based costing, etc. to manage and control cost effectively.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Understand the basics of Costing and preparation of Cost sheet.

CO2: Analyse the cost by applying tools like Marginal costing, CVP analysis and other applications.

CO3: Enabled to use Budgets for controlling cost in Manufacturing or Production Centres.

CO4: Defining cost standards and critically examining the application of Standard costing in a Production Centre.

CO5: Understanding the application of various strategic cost alternatives including Activity based costing.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1											3	1			
CO2											3	1			
CO3	1			1							2				
CO4									1		2				
CO5											2				

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

BASICS OF COSTING 9 Hours

Costing, Elements of costing, Types of cost, Preparation of cost sheet

UNIT 2

COST ANALYSIS 9 Hours

Marginal costing, Cost - volume – Profit analysis, Break-Even- Analysis, Break –Even - Chart, Applications.

UNIT 3

CONTROL TECHNIQUES 9 Hours

Budgeting and Budgetary control, Types of Budgets, Preparation of purchase Budget, Flexible budgets, Cash Budget, Sales Budget, Materials Budget, Master Budget, zero based Budgeting

UNIT 4

STANDARD COSTING 9 Hours

Types of Standards, Setting up of standards, Advantages and Criticism of Standard Costing – Control through variances.

UNIT 5

ACTIVITY BASED COSTING 9 Hours

Transfer Pricing, Target costing, Life Style Costing, Activity Based Costing (only theory)

Text Books:

1. K.Saxena& C.D. Vashist, Advanced Cost Accounting and Cost Systems, 2nd Edition, V.Sultan Chand & Sons Publishers. 2014
2. S.P. Jain & K. L. Narang, Advances Cost Accounting Kalyani Publishers, 1st Edition, 2017

References:

1. J. Blocher, K. H. Chen, G. Cokins and T. W. Lin., Cost Management: A Strategic Emphasis, Irwin/McGraw-Hill, 3d edition, 2008
2. Don R. Hansen, Maryanne M. Mowen, Cornerstones of Cost Management, 6th Edition , Cengage Learning ,2015
3. Roger Hussey, Audra Ong, Strategic Cost Analysis, Business Expert Press, 2012.

HSS18R010	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course aims to clarify the principles and basic concepts of Product Design and Development. Including organizations and understanding of its products. It also aims at enhancing the quality of products. Product Design means recognition of a new product need, information gathering and requirements setting up, unambitious-clear and complete specification list, study on the product's mechanical architecture, selection of materials and production processes and engineering the various components necessary to make the product work. Product Development means identification of market opportunity, creation of product to appeal to the identified market, and finally, testing, modifying and optimizing the product until it is ready for production.

Course Outcomes:

After completing this course, the student will be able to:

CO1: To learn basic concepts related to design and development of New product
CO2: To understand the structured approach towards incorporating quality, safety, and reliability into design
CO3: To learn the concepts relating to simulating product performance and manufacturing processes.
CO4: To understand the technologies related to computer aided group technology
CO5: To learn implications of changes related to Economic analysis.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1				1		1	2					1			
CO2				1		1	2					1			
CO3							2					1			
CO4							1	1				1			
CO5				1				2		1	1	1			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

NEW PRODUCT IDEA 9 Hours

Definition – Design by Evolution and by Innovation - factors to be considered for product design – Production-Consumption cycle – The morphology of design – Primary design Phases and flowcharting. Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly Product strategies, Market research – identifying customer needs – Analysis of product – locating ideas for new products, Selecting the right product, creative thinking, curiosity, imagination and brain storming - product specification

UNIT 2

NEW PRODUCT DESIGN 9 Hours

Task - Structured approaches – clarification – search – external and internal – systematic exploration – conception, selection - methodology benefits. The value of appearance - principles and laws of appearance – incorporating quality, safety, and reliability into design. Man-machine considerations – Designing for ease of maintenance.

UNIT 3

ROLE OF TECHNOLOGY IN DESIGNING 9 Hours

Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing process – Needs for industrial design-impact – Industrial design process – Technology driven products - user driven products – assessing the quality of the product

UNIT 4

METHODS AND PRINCIPLES OF DESIGNING 9 Hours

Methodologies and tools - Design axioms - Design for assembly and evaluation - Minimum part assessment - Taguchi Method - Robustness assessment - Manufacturing process rules - Designer's tool kit - Computer aided group process rules - Designer's tool kit - Computer aided group technology - Failure Mode Effective Analysis – Design for minimum number of parts – Development of modular design – Minimising part variations – Design of parts to be multifunctional, multi-use, ease of fabrication – PookaYoka principles.

UNIT 5

FEASIBILITY ANALYSIS 9 Hours

Estimation of manufacturing cost – cost procedures – Value Engineering - reducing the component cost and assembly cost – minimizing the system complexity – Basics and Principals of prototyping – Economic Analysis: Break even analysis. Classes of exclusive rights – Patents – Combination versus aggregation – Novelty and Utility – Design patents – Paten disclosure – Patent application steps - Patent Office prosecution - Sales of patent rights - Trademarks – copy rights.

Text Books:

1. Karl. T.Ulrich, Steven D., Product Design and Development, McGraw Hill International, 6th Edition, 2016.
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 3rd edition, Prentice Hall of India Private Limited, New Delhi, 2005

References:

1. Richard Crowson, Product Design and Factory Development, 2nd Edition, CRC Press, 2005.
2. Thomke, Stefan, and Ashok Nimgade. "IDEO Product Development." Boston, MA: Harvard Business School Case 9-600-143, June 22, 2000.
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill Higher Education, 4th Edition, 2012.
4. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education

HSS18R011	BUSINESS PROCESS RE-ENGINEERING	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

- This course aims to clarify the principles and basic concepts of Business Process Engineering.
- This course focuses on both quantitative and qualitative analytical skills and models essential to operations process design, management, and improvement in both service and manufacturing oriented companies. The main objective of the course is to prepare the student to play a significant role in the management of a world class company which serves satisfied customers through empowered employees, leading to increased revenues and decreased costs.

Course Outcomes:

After completing this course, the student will be able to:

CO1: To learn the basic concepts related to Business Process Re-engineering.
CO2: To understand the methodologies and tools used for Business Process Re-engineering.
CO3: To learn the concepts relating to benefit/cost analysis and its impact on the business organizations.
CO4: To understand the need for assessment of business re-engineering and the factors contributing to its success
CO5: To learn the best practices used in Business Process Reengineering with illustrations from corporate world.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						1	1	2	1						
CO2						1	1	3	1						
CO3						1		1	1	1	2	1			
CO4	1						1	1							
CO5							2					3			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

BASIC CONCEPTS 9 Hours

Introduction to BPR Definition; the paradigm shifts in production; the positioning concept; the re-engineering visions; the benefits of business re-engineering

UNIT 2

METHODOLOGIES FOR BPR 9 Hours

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process.

UNIT 3

MODELLING THE BUSINESS 9 Hours

Methodologies and Tools for BPR, Process management; dynamic business re-engineering change framework; steps to reengineer the process

UNIT 4

CHANGE MANAGEMENT 9 Hours

Change Management, Planned changes in business re-engineering projects; challenges of business change; business change development. Success factors in re-engineering. The assessment of business re-engineering.

UNIT 5

BEST PRACTICES IN BPR 9 Hours

Best Practices in BPR, Case studies: Bell Atlantic, Nissan, Chrysler, Xerox, and Hewlett Packard etc.

Text Books:

1. Ali K. Kamrani, Maryam Azimi (2011). New Methods in Product Design: New Strategies in Reengineering (Engineering and Management Innovation). CRC Press. 1st ed.
2. Bassam Hussein (2008). PRISM: Process Reengineering Integrated Spiral Model. VDM Verlag Dr. Mueller e.K

References:

1. Harmon, P. (2007), Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals, Elsevier/Morgan Kaufmann Publishers.
2. 2. R. Anupindi et al. (2006), Managing Business Process Flows: Principles of Operations Management, Pearson

HSS18R012	POLITICAL ECONOMY	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This course introduces the political economy of India. It examines the interplay of politics and economics. Some of the key themes to be explored are globalization, economic reform, poverty, redistribution, federalism, political protest, public goods delivery, gender, and ethnic politics. Although this class focuses specifically on India, many the themes discussed in this course are functions of institutions, rights, Party Systems and challenges.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Explain the key concepts of political economy analyse the significant developments in the political ideologies
CO2: Describe the salient features of the constitution of India and its functions and interpret, integrate and critically analyse the fundamental rights duties and responsibilities
CO3: Understand the Political party system their evolution and role in the economy
CO4: Understand the various ideological of Indian Political Thoughts
CO5: Have a deep understanding and appreciation of India undergoing major economic and social transformation

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO2						1		3				1			
CO3						1		2	1	1	1				
CO4											1				
CO5	1						1								
							1					1			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

BASICS OF POLITICAL ECONOMY 9 Hours

Political Economy as a Method, perspectives, Politics as Reproduction of Social Relations, State and Social Opportunity, Politics of Rent Seeking -Evolution of State in India: Historical Roots of planning, Redistribution

UNIT 2

INDIAN CONSTITUTION 9 Hours

The Pre-amble- Fundamental rights and duties, Directive Principles- Offices of the President, Prime Minister, Cabinet Government, Chief Election Commissioner, and Governor – Parliamentary system and Procedures - The Judiciary system

UNIT 3

PARTY SYSTEM 9 Hours

National and regional political parties, ideological and social bases of parties; patterns of coalition politics; Pressure groups, trends in electoral behaviour; changing socio- economic profile of Legislators.

UNIT 4

INDIAN POLITICAL THOUGHT 9 Hours

Political Ideologies: Liberalism, Socialism, Marxism, Fascism, Gandhism and Feminism - Dharamshastra, Arthashastra and Buddhist traditions; Sir Syed Ahmed Khan, Sri Aurobindo, M.K. Gandhi, B.R. Ambedkar, M.N. Roy.

UNIT 5

CHALLENGES TO INDIAN DEMOCRACY 9 Hours

Uneven Development of Regions in India – Communalism – Regionalism – Violence – Corruption – environmental degradation- illiteracy –population

Text Books:

1. Charles Sackrey, Geoffrey Schneider, Janet Knoedler, Introduction to Political Economy, Dollars & Sense, 8th Edition, 2016.
2. Robert.S.Dimand, Review of Political Economy: An Introductory Text, 1st Edition, Routledge, 2008.

References:

1. Barry R. weingast and Donald A.Wittman, Handbook of Political Economy, 1st Edition, Oxford University Press, New York, 2006.
2. Ed. Sanjay Ruparelia; Sanjay Reddy; John Harriss& Stuart Corbridge, Understanding India's New Political Economy: A Great Transformation, Routledge 1st Edition 2011.
3. M.Laxmikanth, Indian Polity, 4th Edition, McGraw Hill Education, New Delhi,2017.
4. NirajaGopalJayal, PratapBhanuMehra, The Oxford Companion to Politics in India: Student Edition, Oxford Press, 2011

HSS18R013	PROFESSIONAL ETHICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This subject will provide students with ability to understand and analyse managerial problems in industry so that they can use resources (capitals, materials, staffing, and machines) more effectively.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Identify the multiple ethical interests at stake in a real-world situation or practice
CO2: Assess their own ethical values and the social context of problems
CO3: Develop critical thinking skills and professional judgement and understand practical difficulties of bringing about change
CO4: Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work
CO5: Manage differing opinions on complex ethical scenarios. It's important for those confronted with ethical challenges to be able to hold multiple conflicting points of view, without necessarily adhering to any of them.

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						2		3	2		2	2			
CO2		2				2		3	1		2	2		1	
CO3		2				2		2			2	1	2		
CO4						2		3	2		2				2
CO5						2		3	2			1			

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

ENGINEERING ETHICS 9 Hours

Functions of Being a Manager – Stock holder and stakeholder management – Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues

UNIT 2

ENGINEERING AS SOCIAL EXPERIMENTATION 9 Hours

Senses of Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions

and Professionalism – Professional ideals and virtues – Theories about right action – Self-interest – Customs and religion – Use of Ethical Theories.

UNIT 3

ENGINEER RESPONSIBILITY FOR SAFETY 9 Hours

Corporate social responsibility - Collegiality and loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Discrimination.

UNIT 4

RESPONSIBILITY AND RIGHTS 9 Hours

Moral imagination, stake holder theory and systems thinking - One approach to management decision – making Leadership.

UNIT 5

GLOBAL ISSUES 9 Hours

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample code of conduct

Text Books:

1. Mike Martin and Roland Schinzinger, Introduction to Engineering Ethics, 2nd Edition, McGraw Hill, 2010.
2. Charles D Fledderman, Engineering Ethics, Pearson, 2011.

References:

1. R.S.Nagarajan, Text book on Professional Ethics and Human Values, New Age International, 2007.
2. Gail Baura, Engineering Ethics- An Industrial Perspective, 1st Edition, Academic Press, 2006.
3. Charles e. Harris, Michael s. Pritchard and Michael J. Rabins Texas, Engineering Ethics-Conecpts and Cases, 4th Edition, Cengage Learning, 2009.
4. Charles BymsFleddermann, Engineering Ethics, Pearson, 2008.
5. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2013.
6. Dr.V.Jeyakumar, Mathematics, Lakshmi Publication, Chennai, 2014

HSS18R014	OPERATIONS RESEARCH	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

It is essential for professionals in any field to understand the ethical problems and principles in their field. The general principles of professional ethics will be examined, as well as the distinctive problems. This course is presented in three parts: theory; case studies; and research and presentation. Theory includes ethics and philosophy of engineering.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Identify and develop operational research models from the verbal description of the real System.
CO2: Build and solve Transportation Models and Assignment Models
CO3: Use mathematical software to solve the proposed models.
CO4: Develop a report that describes the model and the solving technique, analyse theresults and propose recommendations in language understandable to the decision-making processes in Management Engineering.
CO5: Design new simple models, like: CPM, MSPT to improve decision –making and develop critical thinking and objective analysis of decision problems

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		2			2	2		3			1		2	2	
CO2		1	3	2	2								1	1	
CO3	2	3	2		3								3	2	
CO4		2	3		3								3	2	1
CO5	2	3	3		3								3	2	2

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

LINEAR PROGRAMMING BASICS 9 Hours

Introduction to applications of operations research in functional areas of management - Linear Programming - formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases - Dual simplex method

UNIT 2

TRANSPORTATION MODELS AND ASSIGNMENT MODELS 9 Hours

Transportation Models (Minimising and Maximising Cases) – Balanced and unbalanced cases – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods - Check for optimality - Solution by MODI / Stepping Stone method - Cases of degeneracy - Transhipment Models - Assignment Models (Minimising and Maximising Cases) – Balanced and Unbalanced Cases - Solution by Hungarian and Branch and Bound Algorithms - Travelling Salesman problem - Crew Assignment Models.

UNIT 3

INTEGER LINEAR PROGRAMMING AND GAME THEORY 9 Hours

Solution to pure and mixed integer programming problem by Branch and Bound and cutting plane algorithms - Game Theory - Two Person Zero sum games - Saddle point, Dominance Rule, graphical and LP solutions.

UNIT 4

REPLACEMENT MODELS AND DECISION THEORY 9 Hours

Replacement Models-Individuals Replacement Models (With and without time value of money) – Group Replacement Models - Decision making under risk – Decision trees – Decision making under uncertainty- Hurwicz criterion-Expected Monetary Value criterion-Expected Value of Perfect Information(E.V.P. I.)

UNIT 5

PROJECT MANAGEMENT METHOD AND SIMULATION 9 Hours

PERT / CPM – Drawing the network, computation of processing time, floats and critical path. Resource levelling techniques - Application of simulation techniques for decision making

Text Books:

1. Kalavathy S, Operations Research, Vikas Publishing House, 4TH Edition, 2013.
2. Paneerselvam R., Operations Research, Prentice Hall of India, 2ND Edition, 2006.
3. Tulsian P.C, Vishal Pandey, Quantitative Techniques (Theory and Problems), Pearson Education, Asia, First Indian Reprint 2002.

References:

1. D.S.Hira, Problems in Operations Research, Kindle Edition, S.Chand, 2010.
2. Prem Kumar Gupta and D.S. Hira, Operations Research,S.Chand, 2016.
3. R.C.Mishra,Principles of Operations Research, 1st Edition, New Age International 2011.
4. KantiSwarup, P.K.Gupta and Man Mohan, Operations Research, 15th Edition, Sultan Chand and Sons 2010

HSS18R015	TOTAL QUALITY MANAGEMENT	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Humanities Elective				
Course Type	Theory				

Course Objective:

This subject provides students with the knowledge to understand the philosophy and core values of Total Quality Management (TQM). It helps to determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization; apply and evaluate best practices for the attainment of total quality. Students who complete this course will be able to critically appraise management techniques, choose appropriate statistical techniques for improving processes and write reports to management describing processes and recommending ways to improve them.

Course Outcomes:

After completing this course, the student will be able to:

CO1: Understand the role and nature of quality in evolving international economic conditions
CO2: Apply the Principles of Quality Management for real time problems.
CO3: The quality encounter process, including supporting facilities and customer requirements/characteristics
CO4: Classify quality measurement methods and continuous improvement process
CO5: Frame Management strategy methods, including identification, development, implementation and feedback processes

Mapping of Course Outcome(s):

CO / PO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2					2				2					
CO2		2					2	2	2		3	2	2	1	
CO3	2				3		1	2				1			
CO4						1	2	2		3	2	2		2	
CO5						2			2	2	3	1	2		

3- Strong Correlation; 2- Medium Correlation; 1- Low Correlation

Course Topics:

UNIT 1

INTRODUCTION TO QUALITY MANAGEMENT 9 Hours

Definitions – TOM framework, benefits, awareness and obstacles - Quality – vision, mission and policy statements - Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality

UNIT 2

PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT 9 Hours

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology.

UNIT 3

STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY 9 Hours

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed - Process capability – meaning, significance and measurement – Six sigma concepts of process capability - Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve - Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

UNIT 4

TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT 9 Hours

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation.

UNIT 5

TAGUCHI TECHNIQUE 9 Hours

Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio - Seven old (statistical) tools - Seven new management tools - Bench marking and POKA YOKE

Text Books:

1. PoornimaM.Charantimath., Total quality management, Pearson Education, 2nd Edition, 2011.
2. Dale H.Besterfield et al, Total Quality Management, Perarson Education, Thrid edition, (First Indian Reprints 2004).

References:

1. ShridharaBhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition, 2002.
2. Jams R. Evans, Total Quality: Management, Organisation and strategy, 4th Edition, South-Western College, 2004.
3. Vincent K.Omachonu, Joel E.Ross, Principles of Total Quality, 3rd Edition, CRC Press, 2004.
4. S.Rajaram, M. Sivakumar, Total Quality Management, Wiley Publishers, 1st Edition, 2008

ONE CREDIT COURSES

AER18R391	UNMANNED AIRCRAFT SYSTEMS	L	T	P	C
Pre – Requisites	Nil	3	0	0	1
Course Category	One Credit Courses				
Course Type	Theory				

Lecture 1: Course introduction

Lecture 2: UAS Aircraft Registration

Lecture 3: licensing of UAS Pilots

Lecture 4: Crew Resource Management

Lecture 5: Preflight Inspection

Lecture 6: Basic Flight Controls

Lecture 7: Airspace Classification and Restrictions

Lecture 8: Operations on and near Airports

Lecture 9: ATC Communications Basics

Lecture 10: Piloting Skills

Lecture 11: Piloting Skills

Lecture 12: Aviation Weather

Lecture 13: Aircraft Weight and Balance

Lecture 14: Knowledge Test Preparation

Lecture 15: Crewed UAS Operations

AER18R392	SOLID ROCKET PROPULSION	L	T	P	C
Pre – Requisites	Nil	3	0	0	1
Course Category	One Credit Courses				
Course Type	Theory				

Lecture 1: Course overview, SRP history, industrial base, components & terminology energy

Lecture 2: selection criteria of solid propellants, estimation of solid propellant adiabatic flame temperature

Lecture 3: propellant grain design considerations, performance parameters burning rate,

Lecture 4:1D flows Survey, nozzle erosion, two-phase losses, Erosive burning,

Lecture 5: performance density, hazard classification, n-base vs. composite, oxidizers, metals, catalysis, binders, bonding, Aging, processing, exam review

Lecture 6: Kinetics, diffusion, thermal waves, and flame structures

Lecture 7: Heterogeneous vs. homogeneous modeling, Metal combustion, and smoke

Lecture 8: combustion stability

Lecture 9: strand burner and T-burner

Lecture 10: Motor cases & closures, insulation

Lecture 11: nozzles, flex seals

Lecture 12: Thrust vector control

Lecture 13: igniters, applications and advantages of solid propellant rockets

Lecture 14: ballistics

Lecture 15: Burning stability

AER18R393	AERODYNAMICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	1
Course Category	One Credit Courses				
Course Type	Theory				

Lecture 1: Review of Fluid Mechanics

Lecture 2: Stream Function, Potential Function.

Lecture 3: Elementary flows and their combinations

Lecture 4: lifting and Non - lifting flow over the smooth and rough cylinder.

Lecture 5: Thin airfoil Theory

Lecture 6: Prandtl's lifting line theory

Lecture 7: Boundary Layer and Boundary layer growth over flat plate

Lecture 8: Fundamentals of compressible flow

Lecture 9: Shock waves

Lecture 10: Flow through nozzle

Lecture 11: Linearized theory

Lecture 12: High speed flow over airfoils

Lecture 13: Introduction to Hypersonic

Lecture 14: Flow visualization techniques

Lecture 15: High Speed Tunnels

OPEN ELECTIVE (BASIC SCIENCE AND MATHEMATICS)

OEE18R009	LASER TECHNOLOGY	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Open Elective (Basic Sicence and Mathematics)				
Course Type	Theory				

Course Outcomes:

After completing this course, the student will be able to:

CO1: An ability to enhance the modern technological aspects in laser
CO2: To correlate the basic concept of theoretical principles in laser
CO3: An ability to improve the knowledge of various types of laser
CO4: Enormous interest to study the various properties of laser.
CO5: Knowledge of laser applications in various engineering fields

Course Topics:

UNIT 1

Absorption and Emission of Radiation

Concept of coherence – spatial and temporal - Conditions for Producing Laser - spontaneous and stimulated emission - Population Inversion-different methods- Einstein coefficients – negative absorption – Gain and Gain saturation - Saturation intensity - shape and width of spectral lines.

UNIT 2

Threshold Condition and Resonators

Rate equations – optical excitation in three and four level lasers – standing waves in laser – cavity theory – dichroic filter – modes, diffraction theory of the Fabry – Perot interferometer – Types of resonators – stability diagram

UNIT 3

Types of Lasers

Principle, construction, working-Gas lasers:He-Ne laser, , CO2 laser- Liquid lasers: dye lasers, solid state laser: Ruby laser, Nd-YAG laser-applications

UNIT 4

Ultrafast Photonics and Laser Q Switching

Introduction to ultrashort pulse lasers and amplifiers – wavelength conversion – time-resolved experiments – applications of ultrashort pulses – Mode locking – second harmonic generation – theory and experiment – materials for optical second harmonic generation

UNIT 5

Applications

Measurement of distance, velocity, rotation with lasers – laser in communications and computer technology– holography – industrial applications – cutting, drilling & welding – lasers in medicine – laser in research and development

Text Books:

1. Simon Hooker & Colin Webb “Laser Physics” Oxford Press, 2010.
2. William T. Silfvast “Laser Fundamentals” Cambridge University Press, Second Edition, 2008.
3. William S. C. Chang “Principles of Lasers and Optics” Cambridge University Press, 2007. 4.Yehoshua Y. Kalisky “The Physics and Engineering of Solid State Lasers” SPIE Press, 2006.
5. Mark Csele“ Fundamentals of light sources and lasers” John Wiley and sons, New jersey 2004

OEE18R006	Industrial Chemistry for Engineers	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Open Elective (Basic Sicence and Mathematics)				
Course Type	Theory				

Course Outcomes:

After completing this course, the student will be able to:

CO1: To apply the knowledge of electrochemistry to understand the working mechanism of batteries and sensors.
CO2: To understand the process involved in refining of petroleum, cracking of crude oil and manufacturing of fuel gases and to analyze the flue gas.
CO3: To understand the process of adsorption and colloidal state of materials.
CO4: To understand the formulation of protective coatings and to know the process of manufacturing and cleansing action of soaps.
CO5: To know the constituents, composition and manufacturing process of cement, glass and ceramics.

Course Topics:

UNIT 1

Energy Storage Devices and Sensors

Batteries - primary and secondary cells. Primary cell - Dry cell, Mercury cell. Secondary cell - Lead acid battery, Lithium battery. Solar cells & fuel cells (H2-O2, PEFC and SOFC) - principle, construction, working and application. Electrochemical sensors - working, application and merits.

UNIT 2

Fuels and Combustion

Petroleum: Origin, refining, cracking - thermal and catalytic, reforming – thermal and catalytic, knocking and octane number, synthetic petrol - Fischer-Tropsch and Bergius method.
*Fuel Gases***:** Large scale production, storage, hazards and uses of LPG, coal gas, water gas, producer gas, and oil gas. Combustion (Problems). Mass analysis from volume analysis and vice versa. Analysis of flue gas (Orsat's apparatus).

UNIT 3

Applications of Adsorption and Colloidal State

Adsorption: Classification of Adsorption – Adsorption of Gases on Solids – Adsorption from Solutions – Applications of Adsorption.
Colloidal state: Types of colloidal solution –Preparation and purification of colloidal solutions – Characteristics of colloidal solution –Coagulation of sols – Origin of charge on colloids – Stability of colloids – Applications of Colloids – Protective colloids – Emulsions – Gels – Micelles.

UNIT 4

Organic Protective Coatings and Soaps

*Paints & Varnishes***:** Requirements of a good paint. Primary constituents of paints, dispersion medium (solvent), binder, pigments, formulation of paints and varnishes.

Soaps: Classification of soap, manufacture of soaps by hot and cold process, cleansing action of soap and classification of detergents (anionic and cationic).

UNIT 5

Siliceous Materials

Cement: Manufacture - Wet Process and Dry process, types, analysis of major constituents, setting of cement, reinforced concrete.

Glass: Composition and manufacture of glass .Types of glasses- optical glass, coloured glasses and lead glass.

Ceramics: Types- raw materials - white wares, manufacture and uses

Text Books:

1) Jain and Jain, *Engineering Chemistry*, 15th Edition, .Dhanpat Rai Publishing Company, New Delhi, 2005.
2) B.N. Chakrabarty, *Industrial Chemistry*, Oxford & IBH Publishing Co, New Delhi, 1981.
3) B.K. Sharma, *Industrial Chemistry*, 11th Edition, Goel Publishing House, Meerut, 2000.
4) P.P. Singh, T.M. Joesph, R.G. Dhavale, *College Industrial Chemistry*, 4th Edition, Himalaya Publishing House, Bombay, 1983.

OEE18R005	COMBINATORICS	L	T	P	C
Pre – Requisites	Nil	3	0	0	3
Course Category	Open Elective (Basic Sicence and Mathematics)				
Course Type	Theory				

Course Outcomes:

After completing this course, the student will be able to:

CO1: Understand the rules of sum and product of permutations and combinations.
CO2: Analyze the concepts of pigeonhole principle and its applications.
CO3: Identify solutions by the technique of generating functions
CO4: Understand the concepts of Pascal's triangle, the binomial Theorem and unimodality of binomial Coefficients.
CO5: Understand the concepts of the principle of inclusion-exclusion and their applications.

Course Topics:

UNIT 1

Permutations and Combinations

Four Basic Counting Principles, Permutations of sets, Combinations (Subsets) of Sets, Permutations of Multi-sets, Combinations of Multi-sets

UNIT 2

The Pigeonhole Principle

Pigeonhole Principle: Simple Form, Pigeonhole Principle: Strong Form, A Theorem of Ramsey.

UNIT 3

Generating Permutations and Combinations

Generating Permutations, Inversions in Permutations, Generating Combinations, Generating r-Subsets**.**

UNIT 4

The Binomial Coefficients

Pascal's Triangle, The Binomial Theorem, Unimodality of Binomial Coefficients, The Multinomial Theorem, Newton's Binomial Theorem

UNIT 5

The Inclusion-Exclusion Principle and Applications

The Inclusion-Exclusion Principle, Combinations with Repetition, Derangements, Permutations with Forbidden Positions, Another Forbidden Position Problem.

Text Books:

1) Richard A. Brualdi, Introductory Combinatorics, Pearson Education, Inc, China machine press, Fifth Edition, 2009
2) Miklos Bona, A walk through Combinatorics, (Second Edition), *World Scientific Publ. Co.*, 2008.
3) C. L. Liu, Introduction to Combinatorial Mathematics, *Mc Graw Hill Book Company, New York*, 1968

OEE18R008	Photonics and Optoelectronic Devices	L	T	P	C
Pre – Requisites	Nil	3	1	0	3
Course Category	Open Elective (Basic Science and Mathematics)				
Course Type	Theory				

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Know the fundamentals of fibre based optical devices.
CO2: Understand the basic of integrated optical devices.
CO3: Learn about the opto-electronic devices.
CO4: Understanding of nanostructured materials.
CO5: Understanding of quantum devices with applications.

Course Topics:

UNIT 1

Optical Fibre based Devices

Introduction to optical Fibre; Fused single mode fibre directional coupler, Polished single mode fibre directional coupler; Fibrepolariser; Wavelength multiplexer and demultiplexer; Optical fibre switches and intensity modulators; Optical fibre phase modulator; Optical fibre frequency modulator; Optical fibre amplifiers

UNIT 2

Integrated Optics based Devices

Optical directional coupler: directional coupler wavelength filter, polarisation splitting directional coupler; Polarisers: leaky mode polariser, metal clad polariser; Phase modulator;Optical switch; Acousto-optic devices : mode converter , tunable wavelength filter, Bragg type modulator , Bragg type deflector; Magneto-optic devices : TE-TM mode converter, modulators and switches, Ti / LiNbO3 based optical devices

UNIT 3

Optoelectronic Devices

Semiconductor Lasers: homojunction, heterojunction and surface emitting lasers, quantum well lasers; Modulation of lasers; Photodetectors: PIN, Avalanche photodiodes; Optoelectronic modulation and switching devices; Electro-optic Devices; Optoelectronic Integrated circuits; SiO2 / Si based optoelectronic devices.

UNIT 4

Nanophotonics

Nanocomposites: Nanocomposite Waveguides, Random Lasers, Nanocomposites for optoelectronics-Basics of nano-photonics-Introduction to MEMS and NEMS-Working principles: as micro sensors-biosensors, chemical sensors and optical sensors. MEMS/NEMS applications: Applications in automotive industry-health care- aerospace-industrial product consumer products.

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UNIT 5

Quantum Devices

Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots; Density of states in low-dimensional structures; Resonant tunneling phenomena and applications in diodes and transistors; Applications of quantum devices: quantum well and quantum dot lasers, ultrafast switching devices, high density memories, dc and rf squids, multi-state logic circuits, long wavelength detectors ; Quantum Computing (Qualitative)

Reference Book:

1. Joachim Piprek, Semiconductor optoelectronic devices, Academic press Hardbound, 2003
2. A.K. Ganguly, Optoelectronic devices and circuits, Narosa publication, 2007
3. Shun Lien Chuang, Physics of Optoelectronic Devices, Wiley-Interscience; 1st ed.,1995
4. Goure and I Verrier, Optical Fibre Devices, Taylor& Francis; 1st ed., 2001
5. Ray Tricker,Optoelectronics and Fiber Optic Technology,Newnes, 2002
6. K Krishna Reddy M Balakrishna Rao, Nanostructures & Quantum Devices, Campus Books International, 2007
7. RahmanFaiz, Nanostructures in Electronics and Photonics, Pan Stallion press (Year)
8. Guozhong Cao, Nano structures &nanomaterials: synthesis, properties & applications, Imperial College Press, 2004
9. Todd D. Steiner, Semiconductor nanostructures for optoelectronic application, Artech House, INC., 2004
10. Jia- Ming Liu, Photonic Devices, Cambrige University Press, 2005

OEE18R003	MATHEMATICAL BIOLOGY	L	T	P	C
Pre – Requisites	Nil	3	1	0	3
Course Category	Open Elective (Basic Sicence and Mathematics)				
Course Type	Theory				

Course Objective:

To enable the students to understand the concepts of models for single species, interacting populations and dynamics of marital interaction

Course Outcomes:

After completing this course, the student will be able to:

CO1: Learn continuous population models for single species
CO2: Learn discrete population models for a single species
CO3: Understand models for interacting populations
CO4: Analyze the various competitive models.
CO5: Model the dynamics of marital interaction.

Course Topics:

UNIT 1

Continuous Population Models for Single Species

Continuous Growth Models, Insect Outbreak Model: Spruce Budworm, Delay Models. Linear Analysis of Delay Population Models: Periodic Solutions, Real Life Problems related to Growth Model.

UNIT 2

Discrete Population Models for a Single Species

Introduction: Simple Models, Cob webbing: A Graphical Procedure of Solution, Discrete Logistic-Type Model: Chaos, Stability, Periodic Solutions. Discrete Delay Models, Tumor Cell Growth

UNIT 3

Models for Interacting Populations

Predator-Prey Models: Lotka-Volterra Systems, Complexity and Stability, Realistic Predator- Prey Models, Analysis of Predator-Prey Model with Limit Cycle, Periodic Behavior: Parameter Domains of Stability.

UNIT 4

Competitive Models

Competition Models: Competitive Exclusion Principle, Mutualism or Symbiosis, General Models and Cautionary Remarks, Threshold Phenomena, Discrete Growth Models for Interacting Populations, Predator- Prey Models : Detailed Analysis.

UNIT 5

Modelling the Dynamics of Marital Interaction: Divorce Prediction and Marriage Repair

Psychological Background and Data: Gottman and Levenson Methodology, Maital Typology and Modelling Motivation, Modelling Strategy and the Model Equations, Steady States and Stability.

Text Book:

1. J. D. Murray, Mathematical Biology: I. An Introduction, Third Edition, Springer-verlag Berlin Heidelberg, 2002.

References:

1) R.M. Anderson and R. M. May, editors, Infectious Disease of Humans : Dynamics and Control. Oxford University Press, Oxford, 1991..
2) O. Diekmann and J. A. P. Heesterbeek. Mathematical Epidemiology of Infectious Diseases: Model Building, Analysis and Interpretation. John Weily, New York, 2000.

OEE18R004	MATHEMATICAL MODELLING	L	T	P	C
Pre – Requisites	Nil	3	1	0	3
Course Category	Open Elective (Basic Sicence and Mathematics)				
Course Type	Theory				

Course Objective:

To make the students to be capable of doing simple mathematical modelling using differential equations and difference equations.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the mathematical modelling of ordinary differential equation of first order.
CO2: Know about the concepts of mathematical modelling in difference equations and linear difference equations.
CO3: Know mathematical modelling through partial differential equation and study about the mass-balance equations.
CO4: Know the first and second methods of obtaining partial differential equation models.
CO5: Study about the mathematical modelling through delay differential and functional equations.

Course Topics:

UNIT 1

Review of ODE and System of First Order ODE - Mathematical modelling in population dynamics-Epidemics through systems of ODE of first order - Mathematical modelling through systems of ordinary differential equations of the first order

UNIT 2

Difference Equation and its solution - Mathematical modelling through difference equations - The need for mathematical modeling through difference equations some simple models-Basic theory of linear difference equations with constant coefficients.

UNIT 3

Review of PDE and solution of simple linear PDEs, Mathematical modelling through Partial differential equation -situation giving rise to Partial differential equation models-Mass-balance equations.

UNIT 4

First method of getting Partial differential equation models-Momentum balance equations the second method of obtaining PDE models.

UNIT 5

Integral Equations - Solution of Simple Integral Equations - Mathematical modelling through functional Integral, delay differential and differential difference equations

Text Book:

1. J.N. Kapur, Mathematical modelling, New age international publishers, 2005 (Reprint).

Reference Book:

1. Frank R. Giordano, William P. Fox, Steven B. Horton , A First Course in Mathematical Modelling , Cengage Learning Publishers, 5th Edition, 2013.